Cross-Sector Partnerships in Undergraduate Engineering: Exploring U.S. Public and Private Sector Perspectives on Collaboration Processes

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Engineering Education

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December 2, 2025
Blacksburg, VA

Keywords: inter-organizational, collaboration, partnership, engineering education

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Abstract

The United States' economic viability relies on a strong engineering workforce. There is a widening gap between the needs of the workforce and engineering graduates' skills, contributing to the growing threats to the United States' competitiveness as labor markets are fundamentally transformed by technology innovation. Partnerships between industry, government, and academia are created to bridge knowledge gaps, underscored by the belief that education systems better achieve desired outcomes with external influence. These partnerships often fail, however, and we have limited knowledge of what makes them successful. Because of this knowledge gap, the purpose of my study is to advance the understanding of cross-sector partnerships in undergraduate engineering by focusing on antecedents to partnerships and the process aspects of their implementation. To develop this understanding, I designed a qualitative study to explore the perspectives of U.S. public and private sector partners of undergraduate engineering. I conducted semi-structured interviews with twenty individuals representing these non-academic stakeholders. Through a lens of inter-organizational collaboration theory, I interpreted their storytelling and generated insights into how they described their partnership experiences.

Findings highlight how the value perceptions of non-academic organizations impact who they choose to partner with and how partnerships are implemented. Some organizations seek tangible benefits that impact their bottom line such as recruiting talented students—participants who worked for for-profit organizations tended to emphasize this value proposition. Others seek intangible benefits such as supporting student learning, emphasized more by non-profit and government-affiliated organizations. Differing goals can create tension in partnerships, which can be reconciled through mutual understanding, compromise, and open communication. Findings also highlight how individual relationships drive collaboration processes and influence organizational behaviors, and how alumni networks can create strategic advantages to partnering organizations by enabling new partnership opportunities and creating efficiencies in process. Conclusions emphasize the importance of tailoring approaches to each partnership situation, extending current conversations in engineering education research on cross-sector partnerships, contributing new knowledge to support the advancement of partnerships research and related theory, and providing practitioners and policy-makers with actionable insights to inform their approach and influence on partnerships, respectively.

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General Audience Abstract

The United States' economy relies on a strong engineering workforce to develop the products, services, and technologies we use every day. The skills that engineers need to be successful in the workforce are constantly changing, requiring engineering colleges to continuously adjust their education programs in response to these needs. By partnering with organizations who employ engineers, engineering colleges are better equipped to make these adjustments and improve the workforce-readiness of engineering graduates. A common partnership situation is students working on projects provided by industry partners within the university setting. Partnerships between universities and industries often fail because of differences in culture, mission, and values. We have limited knowledge of what makes these partnerships successful. My study sought to generate new insights through the perspective of industry professionals who have experience working with engineering colleges on education programs. I spoke with twenty of these professionals, each representing a unique organization, and asked them about their experiences in terms of why they choose to partner and how they think about the process of partnering with universities.

Through my interpretation of how industry professionals described their partnership experiences, I discovered that organizations seek distinct types of benefits through partnerships in undergraduate engineering which also impacts the relationship between partners. Private businesses often desire tangible benefits like recruiting talented students. Government-run organizations often desire intangible benefits like supporting student learning. The goals of industry partners do not always line up with university goals, which can limit how well they can work together and what can be achieved through partnership. By understanding one another, communicating openly, and making compromises, some limitations can be overcome. The relationships between individuals are an indicator of how well their respective organizations can work together productively. It helps if the industry employees involved in a partnership are alumni of the university partner. What is most important to take away from my study is that no two partnership situations are the same, and people who manage partnerships often need to tailor their approach to each new situation.

Dedication

This work is dedicated to the FIRST (For Inspiration and Recognition of Science and Technology) community, for inspiring my journey into education.

Acknowledgements

To my advisor, Dr. David Knight, thank you for your patience, guidance, and wisdom. Throughout the many twists and turns of my Ph.D. journey, you have been a steady and reassuring voice that kept me focused and motivated.

To my committee members, Drs. David Gray, Jacob Grohs, and Donna Sedgwick, thank you for your support throughout this journey. Each of you challenged me, inspired me, and helped me grow both personally and professionally.

To my friends and colleagues, thank you for the many ways you made my journey enjoyable. A special thank you to Jeremy Brown for your friendship and encouragement as we walked this path together. I also wish to thank Drs. Arthur Ball and Matt Nowinski for your passion and dedication to students, which often inspired and motivated me. I am grateful to Virginia Tech and VT Engineering Education for welcoming me into your community.

To all those who supported my research with feedback, ideas, connections, and encouragement, I am sincerely appreciative. A special thank you to Alyssa Rametta, Afroze Mohammed, Kristina Thorsell, Paul Reeder, and Drs. Brian Novoselich, Samantha Brunhaver, Michael Richey, and Scott Daniel. To my study participants, who cannot be named directly, I am grateful for your time and willingness to share your stories.

To the many students I have worked with, taught, and mentored over the years—too numerous to count—thank you. You brought me joy and excitement during my time at VT. A special thank you to the Competitive Robotics Organization (CRO@VT) for trusting me as a mentor, and to several former students who continually reminded me that I had something valuable to offer: Marco Gonzalez Hauger, Tyler Kraics, and Maxwell Kawada.

To my family, who believed in me, encouraged me, and supported me throughout this journey, thank you. A very special thank you to my wife, Casey Moyer, for your many sacrifices that enabled me to pursue this dream. You are my best friend and biggest fan, and I could not have accomplished this without your love and encouragement. I also thank my dogs (to whom I will have to read this aloud), for all the playtime that kept me grounded during long workdays.

This work was supported by the National Science Foundation through the Graduate Research Fellowship Program under Award Number 2235205. Any opinions, findings, conclusions, or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

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Chapter 1: Introduction

"Across the ever-changing global landscape, societies urgently need 'locally relevant but globally competent engineers' who possess the knowledge, skills, attitudes and values to make a better world. More than ever, engineering education needs a huge (r)evolution… Although industry and academia have different cultures and values, they have the common pursuit of knowledge and human resources development. Thus, they should collaborate to enhance each other's capacities by leveraging resources and ideas (Morell, 2014, p. 16)." Despite this laudable vision and objective, partnerships focused on engineering education between universities and organizations outside of academia are uniquely challenging, and little is known about collaboration processes and how certain features may support or inhibit desirable outcomes. My study explores the perspective of these external partners of universities on collaboration processes, providing insight into the complex issue of engineering workforce development.

1.1 Problem Statement

A central purpose of engineering education in the United States is to deliver a workforce capable of addressing complex societal and technological challenges (NAE, 2004). Economic viability relies on a strong engineering workforce (Eddy, 2010; Morell, 2014), and engineering colleges must continuously adapt their education programs to meet evolving workforce needs (ASEE, 2009; BHEF, 2018; Brunhaver et al., 2018; Duderstadt, 2008; Litman et al., 2023; NAE, 2005; NRC, 2007; Sheppard et al., 2008). Accreditation requirements, like ABET in the United States, push engineering education practitioners to partner with organizations outside of academia to enhance curricula and deliver the skills needed in the workforce (Morell, 2014)—skills that are increasingly dynamic because of rapid changes in industry technologies and workflows (Grant Thorton, 2024). The widening gap between the needs of the workforce and

engineering graduates' skills contributes to the growing threats to the United States' competitiveness in manufacturing and technology innovation (HBR, 2018; Moser, 2021). The growing skills-gap also poses risk to people's livelihoods as labor markets are transformed by innovation (Brookings, 2023; WEF, 2025b). According to The Future of Jobs Report 2025, about forty percent of skills required on the job are expected to change by 2030 (WEF, 2025a), creating conditions of increased uncertainty in the ability of engineering education to meet the evolving needs of the entry-level engineering workforce (Rios, 2022).

The Pursuit of Partnerships in Engineering Education. Engineering colleges often seek partnership and input from organizations that employ engineers when adjusting their education programs to meet workforce needs (Lucietto et al., 2020; Tembrevilla et al., 2023). The pursuit of partnerships is underscored by the belief that education systems that operate without external influence are less effective in achieving desired outcomes than when education systems partner with external stakeholders (Awasthy et al., 2020; BHEF, 2018; Eddy, 2010; Gray & Purdy, 2018; O'Leary et al., 2023). Cross-sector partnerships (CSPs) have historically been created to address societal needs and bridge knowledge gaps between higher education and industry (Etzkowitz, 2003). One of the most significant barriers to economic growth is workforce preparedness (O'Leary et al., 2023), limited by participant isolation in the workforce development ecosystem. Siloed attempts by institutions and businesses to address the engineering labor market challenges, rather than pursuing collaborative approaches, may not be sufficient to narrow the skills gap (BHEF, 2018). Organizations do not often have sufficient knowledge and resources to fully understand systemic problems and address them unilaterally (Wood & Gray, 1991). Education-focused collaborations between higher education institutions

(HEIs) and businesses are recognized to support competitive advantage for partnering organizations (Lucietto et al., 2020; Marinho et al., 2020).

Businesses desire access to talented students (Thune, 2010) to recruit engineering graduates who possess skills applicable to their operations (Lamancusa et al., 2008). The assumption is that access to graduates with requisite skills leads to cost-savings (Brunhaver et al., 2018) and the potential to increase productivity through efficiencies derived from a skilled workforce (Rios, 2022; Tucker et al., 2014). On the other side of the partnership, HEIs desire to advance curriculum (Lucietto & Peters, 2025), access funding (Kunttu, 2017; Rios, 2022), and increase students' employability (Vuoriainen et al., 2024). The assumption is that these improvements lead to increased institutional reputation (Ankrah & Al-Tabbaa, 2015) and ability to recruit talented students and faculty (Thune, 2010). Partnerships in engineering education are one way to create competitive advantage for partnering organizations and improve the workforce readiness of graduates (Conradie et al., 2016; Goldberg et al., 2014; Lamancusa et al., 2008; Shah & Gillen, 2023; Smith et al., 2018; Trembrevilla et al., 2023; Trent Jr. & Todd, 2014), highlighting the role partnerships can play in the workforce development ecosystem (Edmondson et al., 2012).

The Situation for Engineering Education. Partnerships between higher education institutions and businesses are commonly focused on applied research and technology commercialization (O'Dwyer et al., 2023; Perkmann & Walsh, 2007; Prigge & Torraco, 2006). Partnerships focused on recruiting graduates into businesses, which typically happen through career fair-type activities, are also common (Shah & Gillen, 2023). Partnerships on educational initiatives include curriculum development (Lucietto et al., 2020), industrial site visits (Carbone et al., 2020), industrial advisory boards (Genheimer & Shehab, 2009), cooperative education

programs (Haddara & Skanes, 2007), guest speaking engagements (Burns et al., 2018; Goldberg et al., 2014), technology support for educational programs (Wade, 2013), and other activities unique to specific partnership situations (Shah & Gillen, 2023). The most studied forms of industry partnerships in engineering education are engineering design capstone projects, courses, and programs (Shah & Gillen, 2023). These studies are often focused on how capstone learning experiences prepare graduates for their transition to work (Deters et al., 2020; Ford et al., 2019; Paretti et al., 2019), or what is being done in the classroom and the impacts on students (Lucietto et al., 2020). Companies that sponsor capstone projects see value in the opportunity to recruit students into entry-level jobs (Shah & Gillen, 2023), and the potential for students to deliver solutions to complex problems at a lower cost (Goldberg et al., 2014). In capstones and other education-focused partnerships with external organizations that take place within the academic setting (as opposed to the workplace setting, such as internships), collaboration processes are often ad-hoc (Morell, 2014) and unique to the context and situation (e.g., a particular department-driven capstone program).

The Need for Partnership Studies in Engineering Education. Collaboration processes are often overlooked in studies of partnerships (Ankrah & Al-Tabbaa, 2015; Carbone et al., 2016; Kunttu, 2017; Perkmann et al., 2013) or seen as a "black box" (Thomson & Perry, 2006; Wood & Gray, 1991). It is more common to find established structures and processes in research-focused partnerships than in education-focused partnerships (Garber, 2017). Partnerships in education tend to be more fragmented and rely on lower-level university organizations and personnel to manage partnership activities (Lucietto & Peters, 2025). Education-focused partnerships are not unique to the United States context, and countries such as Europe and Australia face similar challenges in navigating process complexities within

partnerships (Ankrah & Al-Tabbaa, 2015). Many prior studies of cross-sector partnerships (CSPs) in engineering education have been conducted outside of the United States (Ankrah & Al-Tabbaa, 2015), which can limit applicability of study findings across international contexts. This lack of applicability is typically because of differing cultures, academic structures, and regulatory environments (Lucietto et al., 2020).

There are also variations in how CSPs manifest across disciplinary domains. For fields such as teaching and nursing education, it is more common to find existing institutional structures and processes that support education-focused partnerships (Thune & Støren, 2015). However, in engineering education it is less common to find these well-established structures and processes (Shah & Gillen, 2023). The partnership models in engineering education are more dependent on the context and situation in which partnerships are formed (Smith et al., 2018). The challenges faced in engineering education for supporting education-focused partnerships are further extended by a general lack of theory in related studies (Ankrah & Al-Tabbaa, 2015; Shah & Gillen, 2023; Thune, 2010; Tucker et al., 2024). The theories that do show up in partnership literature tend to be more focused on institutionalization of partnerships rather than on processes (Prigge & Torraco, 2006). Partnerships are challenging because of differing expectations, goals, and organizational cultures and policies (Eddy, 2010), and there is no clear consensus on how education-focused partnerships should be conducted to generate mutually beneficial (i.e., desired, or successful) outcomes to all parties (Eddy, 2010; Rios, 2022; Vuoriainen et al., 2024).

1.2 Purpose of Study and Summary of Research Design

Given the circumstances of partnerships in engineering education with organizations outside of academia and the need for studies that provide insight into the challenges faced in the field, the purpose of my study was to advance the understanding of cross-sector partnerships in

engineering education. Aligned with this purpose, my study addressed the following central research question: **How do organizations outside of academia describe their experiences partnering with universities on undergraduate engineering?**

Although the emphasis of my study was on the collaboration processes involved with these cross-sector partnerships, understanding why organizations outside of academia (herein referred to as external partners) choose to partner with universities on engineering education was also relevant to the central research question (i.e., the antecedents to the partnership). Additionally, the assumption that every external partner organization shares similar perspectives may not hold true, leading to a need for an answer to the central research question that crossed sectoral boundaries. To answer the central research question, I addressed the following research questions:

RQ1. What antecedents to partnerships are cited by external partners?

RQ2. How do external partners characterize collaboration processes in partnerships?

RQ3. How do the perspectives of external partners vary across sectors?

To address these research questions, I conducted a qualitative interview study focused on the lived experiences of twenty individuals representing unique non-academic (external partner) organizations in partnerships on undergraduate engineering. The interview questions were based on an adaptation of Thomson and Perry's (2006) Inter-Organizational Collaboration (IOC) theorical framework, bringing the core focus of discussions to the process dimensions of study participants' experiences partnering with universities on undergraduate engineering, addressing research question two specifically. The data collection approach also enabled antecedent-related data (e.g., the motivations of partner organizations) to be captured, addressing research question one. My analysis followed the structured and reflexive approach to thematic analysis proposed

by Braun and Clarke (2022), composed of iterative phases of coding individual interview transcripts, and developing themes. The data analysis approach also enabled flexible engagement with interview data to develop insights across sectors on the antecedents and processes, addressing research question three.

1.3 Defining Key Terms

The term "cross-sector partnership" is used throughout my study to describe partnerships between universities and non-academic organizations (e.g., commercial businesses, government-run organizations, and private non-profit organizations). Cross-sector partnerships (CSPs) are also referred to in the literature as university-industry partnerships (Campbell, 2017; Shah & Gillen, 2023; Thune & Støren, 2015), university-industry collaborations (Al-Tabbaa & Ankrah, 2015; Awasthy et al., 2020; Bastos et al., 2021), academic-corporate engagement (Garber, 2017), business-higher education collaboration (BHEF, 2018), university-enterprise collaboration (Tucker et al., 2024), university-firm cooperation (Veles et al., 2019), university-firm relationships (Thune, 2010), industrial-academic collaboration (Wade, 2013), business-nongovernmental organization (NGO) partnerships (Gray & Purdy, 2018), university-industry linkages (Etzkowitz, 2003), university-business cooperation (Rampersad, 2015; Thune, 2010) and other terms used to describe similar situations of cooperative, coordinative, and collaborative arrangements between higher education institutions and external partners. I use the term "external partner" throughout my study to indicate the non-academic sector parties involved in a CSP, placing the academic partners at the center of CSP activity. The term "partnerships" is used throughout my study as shorthand for cross-sector partnerships, with distinctions made when the broader domain of inter-organizational relationships is being discussed.

Partnership and Collaboration Processes. I use the term "partnership" throughout my study to encompass all situations of exchange between universities and external partners. I use the term collaboration when describing the specific process dimensions of partnerships for consistency with the theoretical framing employed by my study. However, there are distinctions between 'partnership' and 'collaboration' to note. The term 'partnership' is often used to convey commitment of parties and the advancement of mutual interests (Morell, 2014). The term 'collaboration' narrowly emphasizes that parties work together to produce something. The terms partnership and collaboration are often used interchangeably in related literature, although Gray & Purdy (2018) suggest distinctions should be made since not all partnerships may satisfy their definition of collaboration or achieve collaborative outcomes. Similar terms used in partnership literature include arrangements (Thomson & Perry, 2006), linkages (Etzkowitz, 2003), alliances (Eddy, 2010), and regimes (Ansell & Gash, 2018). These terms, among others, are used to describe the situation of exchange between entities within or extended from distinct organizations. My study did not force a particular conceptualization of partnership onto the CSP situations of interest but instead acknowledged any CSP situation as a partnership that met the definition of collaboration in my study (described in the theory section of the literature review). This framing can often present overlaps with other terms such as cooperation that are often distinguished from collaboration (McNamara, 2012). This decision was intended to address a broad range of partnership arrangements that manifest within CSPs in engineering education.

Engineering Education. Engineering education broadly refers to the practice of teaching and learning engineering, which can happen in diverse learning contexts and outside of formal learning environments. Engineering education as a field of scientific inquiry for teaching and learning in higher education is thought to have emerged in the late nineteenth century, although

as a discipline of study its roots are often traced to the establishment of the US Military Academy in 1802 (Froyd & Lohmann, 2014). The term "engineering education" is used throughout my study to describe four-year engineering degree programs offered by undergraduate colleges. My study was further scoped to those learning experiences that take place within the university's control (i.e., the university has a degree of influence on educational outcomes). This scoping was inclusive of co-curricular and extra-curricular activities that involve learning engineering theory and practice. Engineering education as a practice is generally focused on preparing engineers for entry-level positions in the workforce (Deters et al., 2020; Walther & Radcliffe, 2007), although there is not always agreement with this thinking and others suggest that the mission of engineering education is also to foster the skills graduates will need to navigate their careers (Vuoriainen et al., 2024). My study recognized partnerships in engineering education as one approach to both preparing engineers for entry into the workforce and preparing them for their careers (e.g., learning experiences that emphasize life-long learning skills).

1.4 Study Significance

My study advances the theoretical understanding of partnerships in engineering education, extending existing theories of inter-organizational relationships to these unique partnership situations. It provides insights into collaboration processes unique to the situation of partnerships in engineering education with stakeholders outside of academia. In addition, my study provides a sense of which dimensions of collaboration may be most relevant to partnerships in engineering education. McNamara (2012) describes this effect as a unique 'signature' of collaborative arrangements, which helps to inform the research community's understanding of characteristics that define this type of arrangement within broader literature. Increasing levels of interaction is not always possible or desirable in partnerships (Keast et al.,

2007), so my study also provides insight into the interaction levels appropriate to partnerships in engineering education. As discussed in the literature review section on theory, there is a lack of consensus on how collaboration can be defined, and my study supports the continued development of collaboration theory and informs how the research community may explore and explain partnerships in engineering education in future studies. My study helps to develop a more comprehensive understanding of the working relationships between HEIs and external organizations by expanding on the interaction processes and populating what is often recognized as a sparse continuum in the literature (Keast et al., 2007). My study builds on the current understanding of collaboration theory and offers a different type of perspective than currently exists in literature, often cited as a valued contribution to scholarly work in theory development (Creswell & Creswell, 2017; Ostrom, 1998). The specific topic of collaboration processes within partnerships in engineering education has yet to be examined in the same way as my study, which supports how researchers, in future studies, may continue to advance partnership literature through similar and divergent research design choices. Braun and Clarke (2022) suggest that qualitative analyses contribute to a 'rich tapestry of understanding' that may inform how other researchers approach similar studies. Consequentially, the analyses in my study inform future research approaches by leaning on well-established methods for analyzing collaboration processes (Ostrom, 1998), demonstrating the utility of the research methods I use and how they address certain aspects of studying partnerships.

Advancing the Practice of Partnerships in Engineering Education. My study advances the practice of partnerships in engineering education, bridging the gap between assumptions often implicit in partnerships (Ankrah & Al-Tabbaa, 2015) and the realities perceived by participants in my study. My study may be of interest to engineering education

professionals who desire to enhance their collaborations with external partners by offering practical insights on collaboration processes (Miller & Morris-Stevens, 2016). These insights may help them improve the efficiency and effectiveness of similar collaborative arrangements, enhancing what Veles and colleagues (2020) refer to as "cross-border collaborative capital." Lucietto and colleagues (2020) suggest that a lack of practical recommendations in existing research on partnerships poses a continuous challenge to engineering educators, who often lack the specialized skills required of inter-organizational work. The insights generated in my study and potential influences on decision-making in higher education leadership also provide benefit to the greater engineering workforce development challenges (e.g., improving the workforce readiness of engineering graduates), through broad, actionable insights relevant to a range of stakeholders. Through the understanding of collaboration processes in partnerships provided by my study, administrators in HEIs may consider adjustments in their existing relationships with external partners in support of their goals (McNamara, 2012). In the literature review, there are discussions on the benefits, best practices, and challenges of CSPs, and my study offers added insights on these topics as revealed by study participants that may influence how practitioners conceive of these topics (Kezar, 2005).

Informing Higher Education Policy. My study informs policy in higher education by offering specific insights into the best practices of collaboration within partnerships in engineering education. These insights may also extend into the sectors beyond academia. Policymakers in HEIs typically desire to avoid redundant efforts in education programs and initiatives (Eddy, 2010), where funding streams may be duplicated or extend beyond their utility in serving educational goals. In engineering education, partnerships can offer a mechanism through which to streamline certain educational pathways, potentially reducing redundancy and

duplication. My study informs policymakers in engineering education in ways that may lead to improvements in the efficiency and effectiveness of regulation and incentive (i.e., reward) structures related to partnerships. The reward structures in engineering education for partnerships are more fragmented than their research-focused counterparts (D'Este & Perkmann, 2011), and my study informs the understanding of these challenges from the perspectives of the educators' counterparts in external sectors (e.g., the participants in my study point to certain challenges within HEIs that limit opportunities and outcomes). Ostrom (1998) suggests that social capital alone is often not enough to solve complex resource problems, such as those discussed as antecedents to partnerships in engineering education in the literature review, and adjustments to related policies may stimulate and encourage new collaborative networks. My study provides insights that may support adjustments to existing policies in HEIs that may be less aligned with their interests in meeting external sector needs or informing new opportunities to partner with external sectors on education.

Chapter 2: Literature Review

Literature on cross-sector partnerships (CSPs) lacks a comprehensive review (Ankrah & Al-Tabbaa, 2015; Awasthy et al., 2020; Lucietto et al., 2020; Perkmann et al., 2013). Over the past decade, there have been studies that have helped to fill this gap. Ankrah and Al-Tabbaa (2015) conducted a systematic review of CSPs that focused on organizational forms (e.g., structures, relationships), partner motivations (e.g., efficiency, stability), activities (e.g., meetings, communication), and factors that enable successful outcomes (e.g., building capacities, navigating social issues). Vuoriainen and colleagues (2024) also conducted a systematic review of CSPs, specific to engineering education, and focused on factors that enable successful outcomes (e.g., commitment, communication). Shah and Gillen (2023) also conducted a systematic review of CSPs, and likely the closest literary work to a comprehensive review specific to engineering education, that explored purposes (e.g., talent pipelines), theories (e.g., experiential learning), research methods (e.g., surveys), and evidence-based practices of CSPs (e.g., providing clarity on benefits to external partners). These systematic reviews touch on collaboration processes involved in CSPs but approach them from different theoretical and literary angles, and none specifically focus on the process aspects of partnerships. These reviews helped to develop a thematic organization of topics and concepts relevant to my study, and the insights and findings within them influence how discussions are structured within the topic areas in the following sections of my literature review.

The purpose of the following literature review is to relate and orient my study within the ongoing dialogue in the literature on partnerships on key themes and debates (Creswell & Creswell, 2017), develop the case for how my study addresses the central research question (Maxwell, 2008), and outline a conceptual framework that is used to guide my study and frame

analyses in the research design (Braun & Clarke, 2013). A specific goal of this review is to cross-pollinate inter-organizational collaboration theory with engineering education research, operationalizing the *Five Dimensions of Collaboration* framework (Thomson et al., 2007) elements within my study, and supporting decision-making in the research design. The review helps to justify my study (i.e., demonstrate how it addresses issues mentioned in the introduction), inform decisions about the methods used to collect and analyze data relevant to the research questions, and becomes a source of data for validating theoretical concepts in the guiding framework. The review first considers the history of CSPs, then provides a thematically organized overview (inspired by the systematic literature reviews mentioned earlier), and concludes with an investigation of theory that builds towards the conceptual framework I use to guide my study.

2.1 History of Cross-Sector Partnerships in Engineering Education

Partnerships between public, non-profit, and private sector companies, governments, and higher education institutions have a long, rich history. Universities have played a significant role in societal and economic advancements through knowledge creation for hundreds of years (Etzkowitz, 2002). Historically, universities provided knowledge creation, and industry translated the knowledge into applications for new products and services (Campbell, 2017). This model still dominates the roles universities and industries play in society today, although universities have been engaging in more technology transfer activities in recent years (Cohen et al., 2024). In the late 19th century, inventors like Nikola Tesla and Alexander Graham Bell collaborated with universities to advance scientific knowledge and its application. The Edison Invention Factory was made up of inventors with university training who were often professors in their field (Campbell, 2017). This period saw increases in industrialization because of society-

changing inventions and the transition between what we acknowledge as the first and second industrial revolutions. Around this time, the Morrill Land-Grant Act of 1862 was passed to promote agricultural and mechanics education, an early example of government initiatives to link education and research activities through R&D partnerships (Feller et al., 2005) and address the increasing need for practical skills in the workforce. Universities such as Massachusetts Institute of Technology (MIT) were generating startup businesses during this period as well (Cai & Etzkowitz, 2020), showing how investments of academic institutions were becoming more diversified and extending from the core mission of education.

Societal challenges became more urgent and complex in the early 20th century, and state policies and interventions that connected industry and academia became more common, especially during times of war (Campbell, 2017). Throughout the Civil War, World War 1, and World War 2, there are examples of government initiatives that incentivized (or required) universities to increase their capacities as technology incubators, and industries as the means to commercialize and deploy technologies (Feller et al., 2005). There are early examples of private sector involvement in engineering education, such as investments from aeronautics companies in the early 20th century to develop skills in graduates needed in the emerging industry (Clauson & Sheth, 2017). However, the modern, post-WW2 history of partnerships provides a clearer picture of how partnerships have evolved and their influence on engineering education. This contemporary period, often characterized by concern for global economic competitiveness, has seen dramatic shifts in partnership activity focused on education with increases in local, state, and federal intervention in the technology and workforce development ecosystems (Feller et al., 2005). An outcome of 20th century advancements was the emergence of the applied research university and collaborative models of CSPs (Etzkowitz, 2002), such as the MIT model from

which most modern partnerships have evolved over the century (Campbell, 2017). Further historical perspective is provided throughout the discussions in this literature review as they relate to specific topics. What is important to note here is that in the 21st century, models of CSPs and our understanding of their value have not changed significantly, although the number of studies conducted on CSPs has increased over the past few decades (Cohen et al., 2024).

Research on Cross-Sector Partnerships. Bastos, Sengik, and Tello-Gamarra (2021) conducted a global bibliometric study to describe the history of CSP literature from 1969 to 2019. Their findings were presented as a series of generations (we they refer to as phases) separated by significant changes evident in the literary conversations on CSPs. The first generation (what they refer to as the discovery phase, taking place from 1969 to 1979) shows the emergence of CSP-specific studies, often focused on investigations of organizational conflicts of interest and antecedents to collaborative arrangements between universities and businesses. The leading studies during this time sought to identify criteria for successful partnerships and establish the need for CSP research to provide value back to society, with little scholarly work on the education situation of CSPs. The second generation (what they refer to as the development phase, taking place from 1980 to 1999) shows the emergence of more practice-focused CSP studies that consider the role of government and politics in CSPs, and early conversations on how CSPs also informed curriculum development. The turning point in this generation was The Bayh-Dole Act of 1980, which was legislation intended to stimulate research activity between universities and businesses, lowering barriers and raising incentives to those collaborations.

Bastos et al. (2021) proposed that the third generation (what they refer to as the expansion phase, taking place between 2000 and 2010) is marked by dilation of CSPs (i.e., significant increases in scholarly research with greater variation in topics). The agenda for future

research in CSPs starts taking shape during this generation and influential studies, such as Perkmann and Walsh (2007) and Thune (2010), are found to lead the field of inquiry. The turning point in this generation was the emphasis on government involvement in CSPs (i.e., the "Triple Helix" model of partnerships) where policies were introduced to incentivize and regulate technology transfer through CSPs. The fourth and latest generation (what they refer to as the consolidation phase, taking place between 2011 and present day) shows a significant increase in case studies and success stories of CSPs and the theoretical emphasis on social capital (i.e., interaction, in addition to earlier emphasis on interdependencies between organizations). This period has also seen a significant increase in topic areas that address education-specific CSPs. In recent years, Bastos et al. (2021) find that the multi-disciplinary character of CSPs is expanding, there is increased interest in economic growth through partnerships, and the scholarly field of CSPs is beginning to form its own theoretical and disciplinary foundations (i.e., a field of inquiry that has its own language and practices). The following discussion brings in both contemporary and historical understandings to shape the argument for how my study, specifically CSPs in engineering education, offers additional insight to inform present and future work in this emergent field of inquiry.

2.2 Overview of Cross-Sector Partnerships in Engineering Education

Cross-sector partnership (CSP) is a term used to refer to the exchange of products, services, or information between a higher education institution and an external organization. Most commonly, the term (and similar terms) is associated with cooperative or collaborative arrangements between HEIs and external organizations on the transfer or translation of knowledge, technology, resources, or a combination. Although my study is focused on collaborative arrangements, where knowledge and resources are exchanged in the engineering

education space, insights are brought in from the broader literature on CSPs to provide a more comprehensive understanding of the various manifestations of related partnerships. This section of the literature review explores how CSPs (often referred to more simply as partnerships in this section) are commonly categorized and placed on continua that extend from basic, coordinative, and transactional manifestations to more complex, collaborative, multi-faceted, and strategic manifestations. The 'third space' of partnerships, which refers to the tendency of CSPs to operate outside of established institutional structures and norms, is explored to situate these unique partnership types within the broader literature on inter-organizational relationships (IORs, the meta-level theory of partnerships). My study is most concerned with the process of partnering and how partnerships are formed (i.e., antecedents to partnerships), but this chapter also considers how they evolve and the conditions under which they are dissolved or satisfied (i.e., outcomes of partnerships) to fully contextualize the lifecycle of partnerships as described by Wood and Gray (1991). Literature on CSPs (and IORs) is found within multiple disciplinary domains including business management, sociology, and health sciences, and insights are brought in from these domains where they may be transferable to engineering education. Organizing this literature review is inspired primarily by Bastos et al. (2021), who structured their review of CSPs based on motivators (antecedents), forms (manifestations), barriers (challenges), and benefits of partnerships; I also bring in additional topics (sections) such as partnership continua, the 'third space' of partnerships, best practices recommended by related studies, and challenges cited in the literature.

2.2.1 Categorizing Partnerships

Classification systems that have been proposed for CSPs vary in the literature but generally consider four broad categories: (1) research support (e.g., endowment or trust fund),

(2) cooperative research (e.g., joint research ventures), (3) knowledge transfer (e.g., institutional programs and cooperative education), and (4) technology transfer (e.g., product development and commercialization) (Ankrah & Al-Tabbaa, 2015). My study is focused on the knowledge transfer category and refers to it as 'education-focused partnerships' and 'partnerships on education' throughout subsequent discussions. The literature review conducted by Ankrah & Al-Tabbaa (2015) proposes six main organizational forms of CSPs (which they refer to as university-industry collaborations or UICs) that transcend the four categories: (1) personal informal relationships (e.g., guest lectures and workshops), (2) personal formal relationships (e.g., recruiting, hiring, and shared resources), (3) third party (e.g., liaison offices), (4) formal targeted agreements (e.g., collaborative research and education programs), (5) formal non-targeted agreements (e.g., advisory boards and sponsored research), and (6) focused structures (e.g., innovation hubs and consortia). Lucietto and Peters (2015) propose categories of continuing education, technology transfer, equipment and resource provision, academic advisory boards, and research partnerships, demonstrating an integrative approach to a classification system. These and other attempts to map out the spectrum of CSP manifestations, categorizations, and organizational forms have been made, although it is often recognized that arriving at a general or universal classification system is difficult because of the complex patterns evident within most partnership situations (D'Este & Perkmann, 2011).

The typical approaches for classifying CSPs tend to focus either on the main content of the activities, as Lucietto and Peters (2015) propose, or the sphere of activities associated with a particular interaction, like Ankrah and Al-Tabbaa (2015) propose. Although the focus of my study is on education-focused CSPs, there may be connections between distinct types of activities (e.g., educational components of research partnerships). The specific phenomenon of

interest may not be easily disentangled from broader phenomena evident in partnership situations. Consequently, my study often refers to partnership activities beyond engineering education to place the phenomenon of interest within the broader sphere of CSP activities. In other words, understanding what happens in 'research' type partnerships is often helpful to make sense of what happens in the 'education' type of partnerships. Insights may not always be transferable between these types, so my literature review attempts to shed light on the differences as well. The two buckets of research- and education-focused CSPs are used as a classification system in the discussions that follow, to explore the variations in partnership processes. USAID employed a similar classification system in a recent report on CSPs (which they refer to as higher education-industry collaborations, or HEICs), dividing the partnerships space into 'research and innovation' and 'teaching and learning' (Rios, 2022). The latter bucket focuses on human capital development and 'teaching for employability,' which are themes with broad literary support and align with the purpose of my study, and the former on technology transfer and application through research partnerships.

Research Partnerships. Research partnerships between universities and industry are the dominant form of CSPs (Campbell, 2017) and have been well studied over the past half century (since the Bayh-Dole Act, especially). These partnership types are often defined as inter-organizational arrangements for joint research and development (Perkmann & Walsh, 2007). Research partnerships have historically been created to address societal needs through the diffusion, translation, and utilization of knowledge and technology (Etzkowitz, 2003). The situation in engineering is like other domains such as medicine where outputs of research activities are commonly intended for applications in industry. Research partnerships are often categorized as collaborative research, contract research, and consulting (D'Este & Perkmann,

2011), or similar combinations of these partnership types. These types of classifications tend to focus more on the mobility and transfer of technology than the relationships within partnerships (Perkmann & Walsh, 2007), often leading to categorizations that separate partnerships from services. This distinction aligns the amount and depth of linkages between organizational participants in a UIP with their levels of interaction. Inter-organizational collaboration, discussed in the theory section, also makes these distinctions to classify a partnership as a collaboration (or something that is not a collaboration), although as noted earlier my study does not make such rigid distinctions. It is important to understand the nature of research partnerships, even though the structures for education partnerships may have distinctive characteristics, to develop a more comprehensive understanding of collaboration processes within partnerships.

Education Partnerships. Education partnerships are often referred to as partnerships on applied learning (Kunttu, 2017), experiential learning (Lamancusa et al., 2008), and work-integrated learning (Carbone et al., 2020; Rampersad, 2015; Vuoriainen et al., 2024) in related literature. Thune (2010) organizes education-focused partnerships (using the term collaboration) into three types: (1) those focused on developing or refining education programs (e.g., curricula and course development), (2) those focused on teaching and learning processes (e.g., guest lecturing and student projects), and (3) those focused on the transition between school and work (e.g., co-ops and internships). Thune (2010) also acknowledges other, less common partnerships such as lifelong learning (e.g., continuing education programs) and tailor-made learning experiences (e.g., industry-led workshops at universities). My study is interested in all three types proposed by Thune (2010) where they occur within the university's control (a scoping decision that is discussed throughout this study). My study also leans on insights from studies that consider phenomena outside the scope of interest, to provide a more comprehensive

understanding of partnerships in engineering education. The goal in this part of the review is to develop a complete picture of the range of partnership types and ways of classifying them, to situate the specific phenomenon of interest within the broader literature. A separate section of this review is devoted to an in-depth investigation of education partnerships within the study scope. To better understand partnership types and the processes within them, scholars often place partnerships on continua that emphasize their degree of formality, levels of interaction, and other elements that expose the variations in how partnerships manifest in education.

2.2.2 Partnership Continua

Partnerships are often distinguished between contractual and collaborative arrangements (Gray & Purdy, 2018), or placed on other continua to make these distinctions such as 'loose' and 'tight' coupling (i.e., depth of interdependency and interaction) (Eddy, 2010), links that lead to relationships (i.e., there is a linearity to relationship development) (Perkmann & Walsh, 2007), transactional to strategic partnerships (BHEF, 2018; Rios, 2022), informal alliances to formal partnerships (Eddy, 2010), and cooperation to collaboration (Keast et al., 2007; McNamara, 2012). These and other continua articulate linearity in partnerships and highlight variation in partnership types and how they are understood in theory and practice. There are two continua particularly well-suited for making sense of CSPs in engineering education, given their reference in related literature: the continuum of transactional to strategic partnerships, and the continuum of cooperation to collaboration.

From Transactional to Strategic. An often-discussed continuum for CSPs proposes that they take the form of transactional (limited duration and narrowly focused), operational (short-term and more broadly focused), or strategic (longer-term and multi-faceted) (Campbell, 2017; Marinho et al., 2020; Rios, 2022) arrangements. Transactions on research, open innovation, and

technology commercialization are ubiquitous to CSPs (O'Dwyer et al., 2023; Perkmann & Walsh, 2007; Prigge & Torraco, 2006). Transactions on recruiting, corporate training, and project sponsorships are also common (Shaw & Gillen, 2023). Operational partnerships are typically informal relationships where organizations work together but do not necessarily share decision-making control (Gillen, 2019). Strategic approaches to partnerships are less common and more complex to develop and sustain, but also more likely to drive economic growth when successful (BHEF, 2013; Eddy, 2010; Rios, 2022). Shared decision-making is often a necessary component of strategic partnerships (Rios, 2022). Strategic CSPs typically include two or more types of exchanges (e.g., research, recruiting, and education) and can involve government or other third-party mediators (e.g., private consulting firms specializing in institutional partnerships, or individuals employed by one or more parties as brokers of the relationship). Collaboration as a process that develops over time is often emphasized in related studies (Gillen, 2019; Gray, 1989; Thomson & Perry, 2006). Partnerships do not often start out at the 'strategic' end of the spectrum but rather evolve over time and along the continuum from informal to more formal relationships (Ring & Van de Van, 1994; Thomas & Lancashire, 2010; Thomson & Perry, 2006; Wood & Gray, 1991). The degree of formality (or intensity of interaction) may be better understood through McNamara's (2012) classification system of cooperation, coordination, and collaboration, based on work by Keast, Brown, & Mandell (2007).

From Cooperation and Coordination to Collaboration. The degree of formality in the interactions between universities and industry is often discussed in CSP literature (Eddy, 2010). Attempting to create a more detailed picture of inter-organizational arrangements and how the range of interactions shows up in inter-organizational settings, Keast et al. (2007) propose a framework for partnerships that places the degree of formality in interactions closely associated

with the ‘level of intensity’ of interaction, on a continuum ranging from cooperation and coordination to collaboration. Cooperation is understood as inter-organizational interaction that accomplishes individual organizations’ goals using existing structures and policies (McNamara, 2012), and often short-term, minimal risk, and less formal (Keast et al., 2007). Cooperation tends to manifest as an exchange of information (Sedgwick, 2017). Coordination is distinguished from cooperation by incorporating formal linkages (McNamara, 2012), such as aligning resources to collaborative efforts, with an increase in benefits and risks (Keast et al., 2007). Like cooperation, organizational entities engaged in coordination often maintain independent authority rather than shared control (Sedgwick, 2017). Collaboration, the most common term used to describe CSPs (Bastos et al., 2021; Gray & Purdy, 2018; Morris & Miller-Stevens, 2016), emphasizes the complexity of goals pursued by participants based on their shared and differing interests, and their interdependence to achieve desired outcomes (McNamara, 2012), with higher risk and a complex mix of informal and formal arrangements (Keast et al., 2007). McNamara (2012) aligns each of these partnership classifications to common elements of partnerships such as organizational autonomy, information sharing, and decision-making, showing how the continuum may be used to add dimensionality to collaboration elements (such as the Dimensions of Collaboration used in my study). Sedgwick and Lemaire (2024) suggest that “decisions to cooperate, coordinate, or collaborate with program partners [can be understood] as strategic responses of avoiding, compromising, or acquiescing, respectively (p. 57).” Collaboration typically involves governance structures that are distinctive of the individual organizations (Sedgwick, 2017), which may be considered as an explicit (e.g., dedicated resources) or implicit (e.g., requires certain individual competencies) ‘third space’ of inter-organizational activity.

2.2.3 The Third Space of Partnerships

It is often acknowledged in CSP literature that 'third space' professionals and organizations are critical to the success and sustainability of partnerships (Eddy, 2010; Edmondson et al., 2012). For research partnerships, technology transfer offices (TTOs) within universities are often cited as fundamental third-party intermediaries (Ankrah & Al-Tabbaa, 2015) that have the necessary expertise and networking abilities to facilitate partnerships (Aswathy et al., 2020; Sjöö & Hellström, 2019). TTOs are also known as industrial liaison offices, business engagement centers, offices of industry relations, offices of industrial partnerships, and other terms that distinguish their organizational situatedness within universities (Garber, 2017). They are usually staffed by specialists who have experience in both academia and industry and can navigate cultural differences between the two environments and individuals involved, often serving as facilitators of partnerships (Garber, 2017; Perkmann & Walsh, 2007). TTOs can be thought of as an institutionalization of collaborative strategies for R&D activity, which may lead to the idea of partnership development as a form of increasing institutionalization or developing a negotiated inter-organizational order (Gray, 1989). There are studies that explore TTOs and their perspective on partnership success (Campbell, 2017), although personal relationships are typically seen as more important for education-specific partnerships than formal instruments like those offices (Awasthy et al., 2020; Sjöö & Hellström, 2019) and often complemented by individual intermediaries.

The Role of the Champion. Studies of CSPs often overlook the role of the champion, although many others refer to their importance for success (Eddy, 2010). Champions are key individuals in partnerships, that may be employed by either participant (or both) and are the primary points of contact and facilitators of partnerships. They are also referred to as third space

professionals (Veles et al., 2020), boundary-spanning individuals (Adams & Lanford, 2021; Edmondson et al., 2012), or simply whatever title-designation is assumed by the managers, facilitators, or other dedicated staff that oversee partnership activity from either organization (e.g., project manager in industry, capstone administrator in university). The role of individual intermediaries in CSPs typically do not fit neatly into either organizational domain, are continuously working across organizational boundaries, and often transcend functional boundaries to facilitate partnership and support communication (Adams & Lanford, 2021; Sjöö & Hellström, 2019; Veles et al., 2020). Eddy (2010) talks about the social capital of partnership champions and how that enables cognitive flexibility (i.e., seeing opportunities for solving problems that leverage the partnership). Edmondson and colleagues (2012) suggest that boundary-spanning individuals function as a cultural bridge, continuously translating and negotiating across cultural boundaries in the exchange between universities and industry. MiSweet (2021) suggests these champions are collaboration leaders who negotiate between individual organizational needs and the needs of the collaboration (also referred to as self and collective interests, respectively), facilitating exchanges, addressing political inequalities, and mitigating tensions that are inherent to collaborative arrangements. The most vital role of the champion is to build and sustain relationships among partners (Veles et al., 2020). The emphasis on the role of the champion in this review also connects to the research design—champions of cross-sector partnerships in engineering education were explicitly sought in the data collection. The body of literature that deals with the 'third space' of partnerships is often focused on the research partnership situation, although many insights on the role of the champion are transferable to the education partnership situation. For education partnerships, there are not

usually formal instruments like technology transfer offices, and the third space of partnerships can be presented in a variety of ways in related literature.

Third Parties of Education Partnerships. One of the most common forms of CSPs in engineering education is the capstone situation (Goldberg et al., 2014; Shah & Gillen, 2023). For capstone programs in engineering education, typically housed within departments of engineering, there is often a champion for facilitating project sponsorships. This champion may be referred to as a capstone administrator, industry partnership coordinator, or other terms that distinguish them from other university staff and position them as a liaison between the university and industry for the purpose of managing capstone project sponsorships. The champion may also be an instructional faculty member for engineering capstone courses or other designated university staff. A primary interest of industry in partnering with undergraduate colleges in engineering education is to recruit skilled students into their workforce (Morell, 2014; Rampersad, 2015; Tucker et al., 2024). Career centers at universities can therefore be considered an important third space for CSPs since they are often the organizational entities that host career fairs and recruiting events. There are also businesses dedicated to brokering CSPs, such as the Business-Higher Education Forum, whose mission is to develop regional and cross-sector workforce initiatives (BHEF, 2025) through direct involvement and intervention in CSPs. Other businesses, such as the non-profit University Industry Demonstration Partnership (UIDP), take a softer approach and instead focus on building networks and alliances between industry and universities, with a mission to support mutually beneficial CSPs by developing strategies for addressing shared challenges (UIDP, 2025). There are other businesses that offer similar services to align university and industry goals for research and workforce development, such as PeopleGrove, IN-PART, and Risepoint, each offering distinct types of services that range from designing one-off

workshops to managing full online degree programs. Exploring these third-party organization types in-depth is beyond the scope of my study, but an overview is provided here to develop a more complete understanding of 'third space' professionals and organizational entities that facilitate CSPs. In the interest of developing a comprehensive understanding of collaboration processes in CSPs that participants in my study speak to, an understanding of the full lifecycle of partnerships is needed to orient these processes.

2.2.4 The Lifecycle of Partnerships

Partnerships can manifest from a range of stimuli—from informal, individual-level relationships to national consortia (Safrit, 2014) and can originate at both individual and organizational levels (Rampersad, 2015). Most often, they form organically between individuals with prior relationships that later lead to organizational involvement (Kezar, 2005; Lucietto et al., 2020; Thomas & Lancashire, 2010). CSPs typically originate from university faculty and staff (Vuoriainen et al., 2024). The incremental pattern of evolving (and scaling) partnerships suggests that small-scale, informal relationships, where risks are low and trust is early in development, can eventually lead to new activities, increased formality, and larger-scale relationships (Perkmann & Walsh, 2007; Thune, 2010). Kezar (2005) suggests that there is no literary support for whether partnerships should be formed at individual or organizational levels, or from informal or formal processes, just that a degree of each is necessary for sustaining them. The lifecycle of partnerships has been conceptualized using the analogy of personal (intimate) relationships (Morell, 2014), where they proceed from 'dating' phases (awareness of need or opportunity), through 'growth' phases (commitment and action), and either proceed to 'marriage' (sustainability) or end in 'separation' (dissolution, either planned or because of diverging interests). Kezar (2005) proposes a similar conceptualization of partnership phases—

from laying a foundation, to developing (or re-defining) a framework, to systematic evaluation in determining continuation, although my review does not specifically cover the evaluation of partnerships. What happens within partnerships (the 'growth' phase), the activities, and processes of the partnerships, is central to my study. Making sense of the full lifecycle of CSPs requires a close consideration of the pre-conditions for partnerships (i.e., what motivates individuals and organizations to partner across organizational domains) (Gray & Purdy, 2018) and the post-conditions (i.e., termination or dissolution).

Antecedents of Partnerships. There are invariably different motivations for pursuing partnerships such as solving complex problems and accessing resources, information, or skills (Awasthy et al., 2020), although less attention is usually given in existing studies to the pre-conditions that need to be understood prior to establishing partnerships (Kezar, 2005). A prevailing belief of pursuing CSPs is that although universities and their external partners have inherent differences, their interests can also align productively (Garber, 2017; Safrit, 2014; Thune, 2010). An alternative perspective of this belief is that few organizations have the knowledge-building capacity and resources to understand and address issues unilaterally, and through partnerships these limitations can be overcome (Gray & Purdy, 2018). Huxham and Vangen (2005) suggest that self-interest motives are a necessary pre-condition for collaboration and leads to the thinking that partnerships should only be pursued if there is a clear opportunity to improve organizational performance or lower costs (Thomson & Perry, 2006). Other studies consider the collective interest, rather than the self-interest perspective, to make the case for antecedents of partnerships. Interdependence is often cited (Ansell & Gash, 2017; Edmondson et al., 2012; Gray & Purdy, 2018; Keast et al., 2007), and there are theories of interdependency that have been used to explain partnerships (discussed later in the section on theory). Ankrah and Al-

Tabbaa (2015) propose that motivating factors of partnerships include necessity, reciprocity, efficiency, stability, legitimacy, and asymmetry. They align both university and industry perspectives to each of these factors in their literature review. For example, for the efficiency factor, universities desire access to funding for research, whereas industries desire to commercialize university-based technologies. Employment opportunities for graduates are mentioned for the university-perspective on efficiency and advancing curriculum for the stability factor. Accessing students for internships and hiring is mentioned for the industry perspective on reciprocity and continuing professional education for the efficiency factor. Other antecedents commonly mentioned in the literature are the need for resources (Aswathy et al., 2020; Eddy, 2010; Morris & Miller-Stevens, 2016; Sjöö & Hellström, 2019; Thomson & Perry, 2006) and partners that have a prior history of successful collaboration (Eddy, 2010; Huxham & Vangen, 2005; Schaefer, 2022; Sjöö & Hellström, 2019; Thune, 2010). There are also challenges mentioned for partnership pre-conditions such as understanding what may be possible to achieve through collaboration (Gillen, 2019) and how to establish partnerships.

Forming Partnerships. An earlier section discussed continua for partnership types using ideas such as the 'degree of formality' to place them. Overlaps are evident when looking at the lifecycle of partnerships and particularly how they are formed. Thomas & Lancashire (2010) proposes that establishing partnerships can be conceptualized as a continuum, from interpersonal relationships of individuals to enterprise-level, multi-party alliances. They may be born of passive opportunity or personal interest, or intentional, strategic organizational initiatives (Morell, 2014). It is often recognized that individual characteristics influence partnership types and intensity more-so than organizational characteristics (Rampersad, 2015), so it might make sense that partnerships are often formed through personal networks and relationships. Others

claim they often are formed because of resource scarcity around a complex issue (Morris & Miller-Stevens, 2016) and solving the issue requires partners to bring resources that others need (Thomson & Perry, 2006). The tension between these two distinct ideas and theories of partnerships (interdependence and interaction) are recurrent themes in CSP literature and are explored in depth in a subsequent section on theory.

Ending Partnerships. A final topic for this part of the review, that receives less attention in related literature but is critical to understanding lifecycles, is understanding how partnerships end. In a life-cycle model proposed by Williams, Merriman, and Morris (2016), there are decision points for ending an inter-organizational arrangement that result in either departure (dissolving the partnership) or rejuvenation (re-forming with new purpose and goals). The factors they propose that influence these decision-points are changes in the environment and participants. What is salient in many studies and theories of collaboration is that partnerships are unlikely to be sustained beyond their usefulness to participants (Adams & Lanford, 2021; Morris & Miller-Stevens, 2016), at least when they are not guided by policy or mandate (a topic not covered in this review as it extends beyond the CSP situations of interest to my study). There are claims that partnership sustainability (and success) is more likely with a strong 'third space' of partnership activity, such as individual and third-party organizational intermediaries (BHEF, 2018; Gray & Purdy, 2018). Often, understanding how partnerships end is revealed instead through discussions on challenges experienced by partners (discussed in depth in a later section). Success and sustainability require a close consideration of the initial benefits of partnerships assumed by partners (i.e., how success is defined and why partnership sustainability is desirable), and studies often discern between benefits to the various stakeholders of partnerships (Thune, 2010).

2.2.5 Benefits of Partnerships

The primary stakeholders of partnerships in engineering education are students, universities, university staff, and the external (e.g., industry, government, non-profit) partners (Safrit, 2014; Thune, 2010; Vuoriainen et al., 2024). This part of the review considers each of the main beneficiaries of partnerships separately, a common approach in CSP literature that attempts to explain why industries partner with universities and vice versa (Vuoriainen et al., 2024). There are several overlaps between benefits to each stakeholder and benefits assumed by all parties, such as enhancing each partner's collaborative capacities (Ankrah & Al-Tabbaa, 2015; Gillen et al., 2021; Kunttu, 2017; Tucker et al., 2024), broadening networks of expertise (Ankrah & Al-Tabbaa, 2015; Schaefer, 2022), fostering innovation (Kunttu, 2017; Morell, 2014), brand visibility and reputation (Goldberg et al., 2014; Schaefer, 2022; Vuoriainen et al., 2024), access to resources (Eddy, 2010; Kezar, 2005), and fostering a culture of lifelong learning (Lucietto & Peters, 2025). Safrit (2014) expands the 'shared benefits' findings by suggesting they include diffusion of ideas (which can lead to spin-off activities), promoting alumni relations that strengthen organizational relationships, and contributing to local economies. Thune (2010) also mentions that CSPs are valued as part of broader regional engagement, which can lead to strengthening the competitiveness of regions within which certain partnerships are conducted. Partnership activities can also be encouraged and incentivized by federal programs (Safrit, 2014; Schaefer, 2022), which provide grants and other types of funding to support partnerships, including in the interest of improving student learning and workforce readiness.

Benefits to Students. Students are often cited as the primary beneficiaries of CSPs in engineering education (Morell, 2014; Rampersad, 2015; Thune, 2010). Through partnerships, they often benefit from practical, authentic learning experiences (Ankrah & Al-Tabbaa, 2015;

Burns et al., 2018; Kunttu, 2017; Lamancusa et al., 2008; Lucietto & Peters, 2025; Safrit, 2014), gain a deeper, more diverse understanding of the engineering field and contemporary issues (Gillen et al., 2021; Vuoriainen et al., 2024), and become more globally competent as professionals in their fields (Morell, 2014). Through learning experiences enabled by CSPs in engineering education, students may become better prepared for their transition to work upon graduation (Burns et al., 2018; Ford et al., 2019; Goldberg et al., 2014; Thune, 2010; Thune & Støren, 2015; Vuoriainen et al., 2024;). It is often cited that through partnerships, students develop employability and critical engineering skills like teamwork and communication (Burns et al., 2018; Fleming et al., 2024; Lamancusa et al., 2008; Morell, 2014; Rampersad, 2015; Thune, 2010; Thune & Støren, 2015; Tucker et al., 2024). For the capstone situation of CSPs and similar authentic problem- and project-based learning experiences, students also benefit from exposure to real-world projects (Goldberg et al., 2014; Morell, 2014; Tucker et al., 2024) and professional networking (Gillen et al., 2021; Morell, 2014; Rampersad, 2015).

One of the most cited benefits to students is that partnerships increase their employment opportunities (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Kunttu, 2017; Morell, 2014; Rampersad, 2015; Tucker et al., 2024; Vuoriainen et al., 2024). Several other benefits are mentioned in related literature such as improving the quality and relevance of engineering studies (Goldberg et al., 2014; Thune, 2010; Vuoriainen et al., 2024), improving students' understanding of business constraints in engineering work (Morell, 2014), exposure to technologies used in industry (Rampersad, 2015), and improving students' access to industry facilities and equipment (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Safrit, 2014). There are a few other benefits to students mentioned in the literature such as increased professional identity and self-efficacy (Vuoriainen et al., 2024), improved self-awareness of professional

interests (Gillen et al., 2021; Goldberg et al., 2014), and increased motivation, attitudes towards study, and retention in engineering (Gillen et al., 2021; Thune, 2010; Vuoriainen et al., 2024). There are overlaps of these benefits assumed by students to the university partners of CSPs in engineering education.

Benefits to Universities and their Internal Staff. The benefits of CSPs on education to universities share similar characteristics to the benefits of CSPs on research such as access to funding (Kunttu, 2017; Safrit, 2014; Schaefer, 2022; Tucker et al., 2024; Vuoriainen et al., 2024) and enhancing institutional reputation (Ankrah & Al-Tabbaa, 2015), which can have a positive impact on the recruitment of students (Thune, 2010). Other commonly cited benefits to universities include improving student outcomes such as placements and employability (Vuoriainen et al., 2024; Ankrah & Al-Tabbaa; Tucker et al., 2024) and advancing curriculum (Ankrah & Al-Tabbaa, 2015; Lucietto & Peters, 2025; Safrit, 2014; Vuoriainen et al., 2024). Thune (2010) also suggests that universities benefit through a strengthened academic environment and higher quality education programs, which can contribute to improved reputation and recruitment of students. For university staff who are engaged in CSP activities, some studies suggest that teaching faculty may improve learning experiences (as an outcome of partnerships) by making them more relevant to today's technologies (Safrit, 2014; Vuoriainen et al., 2024), that partnerships create opportunity for professional networking and consulting (Eddy, 2010; Goldberg et al., 2014; Morell, 2014), and that they support building credibility and trust for academics among practitioners (Ankrah & Al-Tabbaa, 2015).

Benefits to External Partners of Universities. One of the most important benefits to - external partners (referred to as 'industry' partners in several parts of this review for consistency with language used in related literature) of CSPs on education is access to students (Ankrah &

Al-Tabbaa, 2015; Goldberg et al., 2014; Rampersad, 2015; Schaefer, 2022; Thune, 2010; Morell, 2014; Vuoriainen et al., 2024). Rampersad (2015) refers to this interest as 'try before you buy', which suggests that industry partners benefit from engagement with students that extends beyond traditional forms of vetting (e.g., reading resumes, attending career fairs, and job interviews). Another commonly cited benefit to industry is the opportunity to inform or influence curriculum (Ankrah & Al-Tabbaa, 2015; Lamancusa et al., 2008; Morell, 2014; Thune, 2010; Vuoriainen et al., 2024) and the specific skills students develop (Fleming et al., 2024; Lucietto et al., 2020), which is also suggested as a cost-savings to employers (Brunhaver et al., 2018) who might otherwise need to fill skills gaps once students enter employment. This insight is comparable to the research partnership situation where the interest is in commercializing university-based technologies (Ankrah & Al-Tabbaa, 2015; Kunttu, 2017; Rampersad, 2015) to gain a competitive advantage (Gray & Purdy, 2018; Schaefer, 2022; Tucker et al., 2014), but in this case the broader benefit is more about enhancing human capital than intellectual or economic capital (Thune, 2010).

Other benefits to industry cited in literature include exploring ideas and 'back-burner' projects at low cost and low risk (Conradie et al., 2016; Goldberg et al., 2014; Kunttu, 2017; Morell, 2014; Vuoriainen et al., 2024), access to faculty for potential research partnerships (Ankrah & Al-Tabbaa, 2015; Schaefer, 2022; Thune, 2010; Tucker et al., 2024) and developing a better understanding of engineering curricula (Vuoriainen et al., 2024). There are studies that suggest corporate social responsibility is a potential benefit of CSPs to industry (Ankrah & Al-Tabbaa, 2015; Gray & Purdy, 2018; Smith et al., 2018), although there is little agreement on how this idea shows up through partnerships. For industry professionals (i.e., the individuals themselves), partnerships may provide networking opportunities (Eddy, 2010) and project

management experience for junior staff engineers (Morell, 2014). The benefits mentioned in this section are not exhaustive but provide a broad picture of how various stakeholders may benefit from CSPs in engineering education. There are overlaps that are not clearly distinguished, and the review is structured to identify which stakeholder may benefit the most from partnerships broadly, rather than from specific partnership activities.

2.2.6 Partnerships in Engineering Education

This section of the review focuses on CSPs that relate directly to engineering education and does not go into depth on overlaps with research partnerships or other education activities beyond the field of engineering, although the literature often cites educational outputs of research partnerships and the impact on students as an underdeveloped area of inquiry (Shah & Gillen, 2023; Thune, 2010; Tucker et al., 2024). The goal here is to explore the full representation of CSPs in engineering education with highlights for other, less-common partnerships that may still be within the scope of interest. Significant portions of this literature lean on experiential learning theory (Trembrevilla et al., 2023) to explore and explain collaborative behavior between universities and industries that partner on education for the benefit of student learning. This part of the review is divided into two categories for partnerships in engineering education; those that take place outside of the university's immediate locus of control (e.g., internships and site visits) and those that take place within the university's control (e.g., advisory boards and capstone projects). This review aligns with the scoping of the study with the latter category providing more depth since it falls within scope, although it is also important to understand CSPs that extend beyond the university's control to develop a comprehensive understanding of the various manifestations of partnerships and identify where there may be overlaps.

Outside of the University's Control. Engineering education, per the definition used in my study, happens anytime undergraduate students are meaningfully engaged in learning the theories and practices of engineering, which are not exclusive to the university setting. In fact, industry-based apprenticeships were the primary form of engineering education during the earliest years of the engineering field as we know it today (Feller, 2005). The apprenticeship model has since evolved, and many students now take part in internships and cooperative education programs (which are akin to apprenticeships) within industry to complement their studies. These real-world experiences help students develop workplace-relevant skills such as teamwork, communication, and problem-solving, connecting their coursework learning to practical applications (Burns et al., 2018; Carbone et al., 2016). It is important to note that apprenticeships are still used today (Thune, 2010), even referred to interchangeably with internships and co-ops. Also, not all internships or cooperative education programs are fully outside of the university's control (i.e., some universities are directly involved in those programs). Research on internships and cooperative education programs (which share similar characteristics) is well established, although there are other forms of experiential learning outside the classroom that do not show up as often in literature. Industrial site tours are another way to provide students with meaningful learning experiences, allowing them to observe and interact with the environments relevant to their studies and understand the application of topics discussed in the classroom (Burns et al., 2018; Carbone et al., 2016). There are other forms of CSP activities not covered in this review, such as company-sponsored student competitions or professional society-led conferences, but all the above are less relevant to my study than what takes place within the academic setting through CSPs in engineering education.

Within the University's Control. Capstone design courses are the most common form of CSPs in engineering education (Goldberg et al., 2014; Lucietto et al., 2020; Shah & Gillen, 2023), often covering a significant portion of experiential learning requirements for accreditation (Ford et al., 2019), such as ABET in the United States, EUR-ACE in Europe, and Engineers Australia in Australia. A significant portion of data in my study includes the capstone situation because of its prevalence in CSPs. The capstone situation in engineering education has been well studied, often focusing on how those experiences prepare students for their transition from school to work (Deters et al., 2020; Ford et al., 2019; Paretti et al., 2019). The common model of CSPs in capstone is the external partner providing (defining) projects for student teams and individual professionals (typically engineers) acting as liaisons for their employers, evaluating project results, and providing feedback on progress and project milestones (Goldberg et al., 2014; Trent Jr. & Todd, 2014). Engineering degree programs have a long history of providing high-quality work-integrated learning for students (Carbone et al., 2020) through experiences like capstones, although there are other ways CSPs show up in engineering education beyond the capstone situation.

Burns et al. (2018) suggests that CSPs can also include industry-led case studies, guest speakers, and other engagement activities that complement classroom instruction in various engineering learning situations. A case study by Conradie et al. (2016) investigated a CSP situation where industry professionals brought exploratory projects into classrooms for student teams (at the graduate level), which allowed for higher fidelity prototyping of designs and increased student engagement. A case study by Lamancusa et al. (2008) explored a CSP model known as the 'learning factory', which integrated design, manufacturing, and business aspects of engineering work into the curriculum. Their process involved industry professionals as guest

lecturers, student team mentors, and project subject matter experts. The learning factory case demonstrates a multi-faceted approach to CSPs in engineering education where industry partners also provided guidance on the program and curriculum, typically a function of industrial advisory boards. These types of partnership manifestations are of interest in my study given their novelty and expected variations in collaboration processes. Most accredited engineering degree programs in the United States have industrial advisory boards at the college, department, or program level. These boards provide guidance and feedback on curricula by providing insight into current industry practices (Smith et al., 2018; Thune, 2010). This type of influence on student learning tends to be more passive than active, such as the learning factory case or guest lecturing. Other common manifestations of CSPs in engineering education not covered in-depth here include career fairs and recruiting activities on university campuses, extra-curricular activities such as student competition teams (that often include industry sponsorships), and professional societies that connect students with professional settings such as conferences, workshops, and engineering design competitions. Although my study is interested in the various manifestations of CSPs in engineering education, as they provide an anchoring for sampling and scoping, the primary interest for my study is in the processes that guide the activities which may include meetings, communication, training, and personnel mobility (Ankrah & Al-Tabbaa, 2015). What has not been covered in this part of the review yet is what the literature reveals about the best practices recommended for partnerships, and the challenges that are commonly experienced within them.

2.2.7 Best Practices of Partnerships

There is no universal definition of success in CSPs to guide best practices for all situations (Thune, 2010) because of the inherently different goals and activities associated with

each unique situation. However, insights from CSP literature may help to identify common themes. Best practices are also called success factors or characteristics of effective partnerships in literature (Thune, 2010). For the research partnership situation, most studies provide insight into best practices from the perspective of their sampling (Awasthy et al., 2020), although often acknowledge the limitations of transferability to other situations. The same issue applies to assessing outcomes of CSPs where the situated nature of partnerships and differing perceptions of success among stakeholders do not often lead to a guiding framework for best practices (Thune, 2010). There are studies that attempt to thematically organize success factors of CSPs such as Thune (2010) who propose categories of contextual, organizational, and process factors. These attend more to a system-level of analysis in best practices which offers unique insight into situating processes within CSPs. Vuoriainen et al. (2024) propose categories of clarity, communication, commonality, commitment, continuity, and confidence, which provides slightly more granularity and with an emphasis on the social context (and dilemmas) of partnerships.

Tucker et al. (2014) propose categories of structure, culture, relations, and materials, more of a harmony between the system- and social-level approaches by Thune (2010) and Vuoriainen et al. (2024), although their work is more focused on the research partnership situation. Each of the attempts from these scholars to capture and organize best practices for CSPs offers useful insight to my study but in distinct ways. Thune's (2010) model helps to tease out process factors from the broader range of ideas about best practices, and Vuoriainen et al.'s (2024) and Tucker et al.'s (2014) models share similar characteristics to the inter-organizational collaboration model employed by my study. However, none of these categorizations focus on the specific insights themselves but bucket them into higher order constructs, and none are specific to the education partnership situation. This part of the review will lean on common themes and

insights across these and other CSP studies to propose a thematically organized overview of best practices in the education partnership situation. The best practice themes for partnerships that will be reviewed in this section are multi-level support, boundary-spanning capacities, and social capital resources. These themes are not universal nor mutually exclusive but help to align ideas that are closely related and may be relevant to CSPs in engineering education.

Multi-Level Support. A common insight across CSP studies is that success may be highly dependent on multi-level organizational support from both parties (Campbell, 2017; Eddy, 2010; Lucietto et al., 2020; Morell, 2014; Safrit, 2014; Thune, 2010), including executive commitment and active engagement. Edmondson et al. (2012) takes this insight a step further and claims university leadership is vital to partnership success. Thune (2010) provides an alternative point of view and suggests that top-down leadership support is not always the solution since department levels may have more autonomy in certain institutional contexts (which may be the case for engineering in most institutions). Beyond leadership support, other best practices mentioned include partners each having organizational structures dedicated to supporting partnerships (ref the earlier discussion on the third space of partnerships) (Campbell, 2017), that the backgrounds and objectives of each partner have complementary characteristics aligned to partnership goals (Safrit, 2014), that reward structures and recognition support individual motivation and continuity (Tucker et al., 2024), that there should be clear guidelines and objectives for partnership operations (Campbell, 2017; Safrit, 2014), and that equity in human capital resources dedicated to the partnership should be carefully considered (Eddy, 2010; Edmondson et al., 2012; Thune, 2010; Tucker et al., 2024).

Boundary-Spanning Capacities. Universities and their external sector partners have distinct cultures (Eddy, 2010; Gillen et al., 2021; Morell, 2014; Safrit, 2014), necessitating

boundary-spanning capacities to understand and bridge cultural gaps when partnering (Edmonson et al., 2012; Sjöö & Hellström, 2019). Studies of CSPs often suggest that key individuals with boundary-spanning capacities, also called champions (i.e., representatives of partners or partnership), are critical to success (Edmondson et al., 2012; Lucietto et al., 2020; Morell, 2014; Thune, 2007, 2010). Morell (2014) suggests characteristics of these individuals are also important and include passion, courage, credibility, and people skills. Thune (2010) suggests that collaborations often fail (temporarily or permanently) if these key individuals leave the partnership. Another important insight into best practices that are related to boundary-spanning is flexibility. Several studies suggest that flexibility should be built into the structures and processes of partnerships (Edmondson et al., 2012; Safrit, 2014; Tucker et al., 2024), as integration is not a static process and partnerships often need to adapt to changes in circumstances (Keast et al., 2007; Kunttu, 2017; Thune, 2010). Part of this flexibility that is important for the education situation is the suggestion that partners do not get hung up on issues of intellectual property and proprietary information (Edmondson et al., 2012). There is tension in this insight, however, with others suggesting that formal agreements and clearly defined structures should be in place (Safrit, 2014; Tucker et al., 2024). Edmondson et al. (2012) also suggest partners should not get hung up on measuring results although there are tensions in this thinking, too (Safrit, 2014). The last important insight for boundary-spanning is that a key success factor of CSPs is developing a shared vision (Edmondson et al., 2012; Morell, 2014), purpose (Campbell, 2017; Eddy, 2010), and goals (Vuoriainen et al., 2024), and that these should be made explicit to all stakeholders of the partnership (Thune, 2010). Trust and compromise, two important social capital resources, are often cited as important for developing a shared vision (Edmondson et al., 2012).

Social Capital Resources. In CSPs, intangible outcomes like developing relationships are often cited as more important than tangible outcomes such as project outputs (Keast et al., 2007; Kezar, 2005; Thune, 2010). Relationships support a collaborative culture and atmosphere conducive to sharing (Kunttu, 2017; Safrit, 2014), help to build trust, respect, and commitment (Thune, 2010), and lead to stronger networks supporting interpersonal relationships (Tucker et al., 2024). Another commonly cited success factor is partners having past relationships and prior partnership experiences (Schaefer, 2022; Sjöö & Hellström, 2019). Thune (2010) suggests that this history between partners supports continuity of partnerships and strengthens individual relationships. The most cited social capital resource of successful partnerships in CSP literature is trust (Awasthy et al., 2020; Campbell, 2017; Eddy, 2010; Kunttu, 2017; Morell, 2014; Thune, 2007, 2010; Tucker et al., 2024), often considered alongside similar resources such as compromise (Eddy, 2010; Safrit, 2014; Thune, 2010), reliability (Morell, 2014), mutuality (Safrit, 2014), honesty and transparency (Morell, 2014; Safrit, 2014; Tucker et al., 2024), and respect (Thune, 2010; Tucker et al., 2024). These social capital resources often lead to simplification of processes, such as access to information, and new opportunities for continued partnership (Awasthy et al., 2020; Thune, 2007) and are strongly interrelated in their impact on partnership success (Thune, 2010). Communication is often cited as key to trust and growth in partnerships (Eddy, 2010; Morell, 2014; Rampersad, 2015; Safrit, 2014; Schaefer, 2022; Thune, 2010). Schaefer (2022) suggests that transparency and clarity in communication are key to long-term sustainability. Kunttu (2017) offers a more pointed suggestion that educational outcomes (e.g., project outputs) should be presented in formats that meet the external partner's needs to ensure utility in real-world applications.

Less commonly cited factors important for success in CSPs are commitment (Kezar, 2005; Kunttu, 2017) and accountability (Tucker et al., 2024). Tucker et al. (2024) suggests that stakeholders need to be convinced of the benefits they receive through collaboration, which may increase levels of commitment and self-accountability. There are tensions in some claims that institutionalization of collaboration (e.g., the functions of technology transfer offices in research partnerships) is a success factor, with some scholars suggesting it may hinder success (Thune, 2010) and others suggesting there is support for it leading to successful long-term sustainability (Mora-Valentin et al., 2004). For the education situation, there is little support for the claim that institutionalization is a best practice, and the following discussions on theory help to frame this argument in terms of how collaborations may evolve over time. For the capstone situation, Goldberg et al. (2014) propose additional recommendations for best practices in working with external partners such as clarity in funding expectations, time commitments, roles in the project, and course process. What is not covered in this review because of limited research is sustainability of partnerships, although Eddy (2010) suggests that both success and sustainability are closely related and rooted in the initial context of how partnerships are formed. Kezar (2005) suggests sustainability is supported by integrating structures and formalizing networks, although the topic of sustainability may also be closely related to challenges found within partnerships.

2.2.8 Challenges of Partnerships

Partnerships often fail (Ankrah & Al-Tabbaa, 2015; Campbell, 2017; Eddy, 2010; Prigge & Torraco, 2006) and can be riddled with conflicts, tensions, and issues. The previous section was focused on best practices, so it is also appropriate to understand what studies on CSPs have found to be barriers, challenges, limitations, and issues in partnerships. This review will not go into the ‘dark side’ of collaborations (e.g., exploitation, unethical behavior) (Bozeman et al.,

2012), which is beyond the scope of my study, and instead focuses on the high-level insights into what can make partnerships challenging. Following a similar approach to an earlier discussion, common insights are grouped under themes proposed to organize insights from the literature solely for this review. The two themes proposed are differing cultures and values, and differing needs and expectations. These themes are not mutually exclusive, and insights provided within these categories are interrelated. What is not covered in depth are negative impacts on students, although Vuoriainen et al. (2024) proposes that these can include more complex assignments, strenuous requirements, limited availability of projects relevant to their interests, and the belief that external partners do not provide adequate support or supervision of students' work. These issues could be attributed to the hindering factors presented in this review, such as cultural norms and values of industry that may not align with academia.

Differing Cultures and Values. Universities and industries typically have distinct cultures and policies (Eddy, 2010; Gillen et al., 2021; Morell, 2014; Safrit, 2014) because of their differing missions. Universities are more focused on graduating students and publishing research, with value placed on knowledge sharing and management processes that tend to be more distributed and informal (Morell, 2014). Industry is more focused on selling products and services, with value placed on knowledge protection and management processes that tend to be more centralized and formal (Morell, 2014). Academia is more focused on learning, and industry on tangible results, so approaches to collaboration can be quite different (Schaefer, 2022) since the institutional goals are fundamentally different (Safrit, 2014). What is not well covered by existing literature are perspectives outside of private, for-profit industry such as private, non-profit organizations and government-run organizations (e.g., federal funded research and development organizations, or FFRDCs)—my study broadens the literature base. Conflicts in

CSPs can arise from differing values, desired outcomes, and approaches to achieving goals (Ankrah & Al-Tabbaa, 2015; Gray & Purdy, 2018; Morell, 2014). Conflicts can also arise from decision-making within partnerships (Gray, 1989), where power dynamics are not always balanced. These types of conflicts are often cited as a challenge, but they can also promote positive change and creative solutions to problems (Menefee, 2016) through mediation and re-framing issues towards productive adjustments in process. The differences in culture and values can also show up as competing interests (Campbell, 2017) such as the desired outcomes for students (e.g., what they are taught or should be able to do following a learning experience) (Gillen et al., 2021), revealing a tension between the mission of academia and industry-defined learning (Kunttu, 2017).

There are also concerns expressed in CSP literature about the long-term impacts of industry influence on curriculum (Thune, 2010) and how that may threaten academic freedom (Ankrah & Al-Tabbaa, 2015; Morell, 2014; Safrit, 2014). Some academics are skeptical about industry interactions in the academic environment (Gillen et al., 2021) which can lead to divisiveness among faculty (Safrit, 2014). Industry has also been criticized for 'poaching' students and faculty (i.e., recruiting outside of conventional, university-driven process) through their engagements with universities (Rampersad, 2015). Some industry concerns for partnerships with universities include inflexibility in the education system (Conradie et al., 2016), limitations of university partnership models (Campbell, 2017), lack of 'industry friendly professors' for curriculum partnerships (Schaefer, 2022), and issues with sharing proprietary information (Ankrah & Al-Tabbaa, 2015; Awasthy et al., 2020; Rios, 2022; Schaefer, 2022). Some university concerns for partnerships with industry include industry instability and high turnover (Safrit, 2014; Schaefer, 2022), inequity in resource distribution internal to the university (Thune, 2010),

bureaucratic and rigid university structures that over-constrain external collaboration (Eddy, 2010; Kezar, 2005), and a lack of capacity for industry to fully engage in discussions of issues and outcomes (Campbell, 2017). Other culturally relevant challenges that are revealed in CSP studies are lack of commitment between partners (Campbell, 2017), lack of understanding of how partners typically operate outside of the collaboration (Safrit, 2014), and lack of understanding how industry involvement benefits students and universities (Vuoriainen et al., 2024), which can lead to differing expectations for partnership outcomes (Gillen et al., 2021).

Differing Needs and Expectations. What each partner expects to gain from CSPs in engineering education may not always align with the partnership goals (Eddy, 2010; Morell; 2014). How success is defined can also vary (Safrit, 2014), as discussed earlier, and Campbell (2017) suggests that there is often insufficient effort to clearly define scope, measures of success, and goals of partnerships. Each partnership situation has unique goals and desired outcomes, and arriving at a shared understanding of partnership expectations and agreement on the measures of success is often challenging (Campbell, 2017; Schaefer, 2022). Perkmann et al. (2013) and Morell (2014) suggest developing these shared understandings of needs and expectations is one of the most common issues in CSPs. Schaefer (2022) attributes these issues, in part, to HEI infrastructure that is not always conducive to meeting industry needs. Some CSP studies suggest a perception of industry that academia moves too slow in partnership processes to meet their needs (Ankrah & Al-Tabbaa, 2015; Morell, 2014; Tucker et al., 2024). Industry may also feel uncertain about what to expect from university partners on education-focused CSPs (Gillen et al., 2021) or how best to support students (Vuoriainen et al., 2024). It can also be difficult to match industry projects to university coursework (Conradie et al., 2016; Goldberg et al., 2014) because of differing expectations and unclear benefits to the industry partner (Vuoriainen et al., 2024).

Industry may be skeptical at times about the return on their investment (of funding and time committed) in education projects (Ankrah & Al-Tabbaa, 2015; Schaefer, 2022) and sometimes feel that students are not skilled enough to deliver results (from projects) that generate business value (Conradie et al., 2016; Goldberg et al., 2014).

For academia, CSPs in engineering education sometime present complex challenges for curriculum planning and assessment (Vuoriainen et al., 2024). There is a belief that these challenges make it difficult to effectively distribute resources (Eddy, 2010) and that collaboration may take too much time away from university staff (Vuoriainen et al., 2024) who may not have the same incentives for taking part in CSPs as researchers do (D'Este & Perkmann, 2011). Some university faculties are also concerned about industry interaction with students, such as the belief that industry partners are sometimes less sensitive to students' other academic demands (Goldberg et al., 2014). Reward structures for faculty taking part in education-focused CSPs and the effects of those incentives (Eddy, 2010; Safrit, 2014) are less understood. Gillen et al. (2021) suggest that these types of systemic issues are not always acknowledged within universities which can present challenges for incentivizing faculty participation in CSPs. As discussed earlier related to the third space, partnerships happen in the inter-organizational domain where individuals from an HEI and a business interact within the boundaries of their common interests. This overview section showed that these unique inter-organizational arrangements tend to exist along continua that speak to the intensity of the interaction, and within a third space where ad-hoc structures and processes are dominant over established forms. The section also discussed the variation in best practices and challenges that existing literature reveals. Accepting that there is not a singular, universal truth in 'how best to partner' is fundamental to most theories of IORs (Thomson et al., 2007). Some theories focus on structural

aspects of partnerships and others on complexities such as power and politics, or more social aspects such as trust (Ankrah & Al-Tabbaa, 2015). A deeper understanding of the ways partnerships are explained and explored is needed to situate CSPs in engineering education within broader theory.

2.3 Theories of Cross-Sector Partnerships in Engineering Education

My study adopts a theory of collaboration to make sense of CSPs in engineering education and the dynamic collaboration processes (the 'how') that guide these partnership situations, with interest in the antecedents (the 'why') of partnership situations. This section builds towards a conceptual framework, an adaptation of Thomson and Perry's (2006) inter-organizational collaboration (IOC) model, to orient the theoretical ideas, concepts, and findings of my study. There are several theories and frameworks that may be appropriate for explaining and exploring CSPs, and a closer investigation helps to show why and how the chosen framework (with its associated theories) may be the best fit over alternatives in my study.

2.3.1 Theories of Inter-Organizational Relationships

The macro-level body of theories in which inter-organizational collaboration is situated is commonly known as Inter-Organizational Relationships (IORs). IOR theory considers a broad spectrum of interdependence and interaction between organizations that extend beyond collaboration. Ring and Van de Van (1994) propose a process framework for developing what they call Cooperative IORs (C-IORs), framing IORs as a repeating sequence of negotiations (e.g., developing expectations and 'haggling' over terms), commitments (e.g., establishing governance structures), and executions (i.e., the actions and behaviors that are defined by the terms and guided by the structures). Like other theories of IORs and especially those that focus on interdependence, C-IORs operate under the assumption that collective action is mediated by

uncertainties within the parties' respective environments and through the collective (Ring & Van de Van, 1994). C-IOR theory proposes that collective action is stimulated by environmental turbulence where individual adaptation is seen as insufficient, and collective strategies are therefore needed to respond to challenges (Gray, 1989; Wood & Gray, 1991). Ring and Van de Van (1994) anchor their theory on transaction cost economics and its focus on efficiencies but also propose that equity (what they often refer to as 'fair dealing') is equally important to understand IORs. A leading assumption of their theory is that "the parties to a cooperative IOR are motivated to seek both equity and efficiency outcomes because of a desire to preserve a reputation for fair dealing that will enable them to continue to exchange transaction-specific investments under conditions of high uncertainty (Ring & Van de Van, 1994, p. 94)." The earlier discussions on tensions within CSPs that relate to interdependence and interaction share similarities and resonance with what Ring and Van de Van (1994) propose as competing interests in efficiency and equity. There are also other views on interdependence between organizations that can stimulate collective action.

Resource Dependency Theory (RDT) shares similar characteristics to C-IORs in its emphasis on managing environmental uncertainties but departs from the foundations of exchange theory (the broader domain of theories in which transaction cost theory falls within) in its emphasis on power (Davis & Cobb, 2010). The premise of RDT is that organizations respond to interdependence (because of environmental uncertainty) by choosing a 'path of least resistance' that maximizes organizational autonomy and minimizes uncertainties (i.e., organizations seek to gain or regain control over their respective environments) (Davis & Cobb, 2010). If my study focused on issues of power in CSPs, modern adaptations of RDT might provide appropriate framing to explore collaboration processes within partnerships. However, CSP literature makes

little reference to the role of power in governing collective behavior beyond what is cited in the discussion on executive support, because the parties of CSPs in engineering education tend to be non-competitors. Systems Theory (ST), a common approach to explaining IORs that also holds promise in studying CSPs, bridges theories of interdependence with theories of interaction, like C-IORs but with a distinct set of assumptions. Adams and Lanford (2021) applied ST in their study of inter-institutional collaboration and highlighted its unique value in viewing the bonds between individuals and organizations as variable, complex, but also symbiotic within broader social systems. From their perspective on ST, it is reasonable to conceptualize CSPs as networks of interactions that take place within hierarchical structures. The boundaries of these structures may be viewed as socially constructed within an open system, where transactions create an equilibrium that enables mutual exchange between the organizations. A leading assumption of ST is that the systems are continuously supported by changing the organizational structures (i.e., organizations and structures are viewed as mutable) (Adams & Lanford, 2021), which may be valuable to organizing contextual elements and exposing the third space of partnerships but may not attend as well to the collaboration processes themselves. Barbara Gray (1989) is a pioneering scholar in IOR theory that also sought to bridge the dominant schools of thought in IORs (theories of interdependence and theories of interaction). She proposed a dynamic and process-oriented theory of IORs that views collaborations as negotiated inter-organizational orders. Her work is foundational to several modern theories of IORs (Thomson et al., 2007) and is critical for the theoretical underpinnings of my study.

2.3.2 Theories of Collaboration between Organizations

The emphasis on reducing environmental uncertainties and responding to environmental turbulence as impetus to collaborate is foundational to many theories of organizations and inter-

organizational relations (Gray, 1989). This underlying assumption (reducing environmental uncertainty), shared by all theories that have been mentioned thus far, is central to explaining most IORs. What is often underrepresented in most theories of IORs are their dynamic and emergent qualities (which a theory like ST may not attend to as well), instead placing emphasis on structural (static) and transactional qualities (Gillen, 2019; Gray, 1989). As Ring and Van de Van (1994) recognized, the social and interpersonal aspects of IORs are equally important and build toward what Gray (1989) refers to as negotiated inter-organizational orders. The idea is that organizations can cope with environmental pressures (i.e., uncertainties and turbulence) by co-constructing and negotiating collective strategies. Although this thinking is like C-IORs, anchoring on negotiated order theory places the social context in which the negotiations take place at the forefront—offering an attractive alternative that resonates with earlier discussions on CSPs in engineering education (e.g., best practices include establishing trust and commitment).

Negotiated order theory suggests that order is achieved through interactions and that organizations are social constructions that continuously adapt to, and become ordered by, changing conditions (Day & Day, 1977). Negotiated order theory suggests that order in collaboration is achieved through conflict as much as consensus (Gillen et al., 2021). As collaboration is conceptualized as a negotiated order in Gray's (1989) theory, negotiations are viewed as mechanisms of change (e.g., structure, policy, or terms) that give organizational factors their emergent quality (Gray, 1989). More plainly, organizations, their structures, and the processes through which collaboration is achieved are viewed as mutable (i.e., subject to change through the collaboration). This type of thinking offers several advantages to studying collaboration processes within CSPs in engineering education. As discussed earlier, the manifestations of these unique CSP situations vary widely, and the best practices point to cross-

organizational dynamics (i.e., boundary-spanning) and view the individual organizations as adapting in ways that enable partnerships (e.g., adjusting policies for sharing proprietary information with non-competitors). Theories of collaboration between organizations that lean on the foundations of Gray's (1989) work enable the dynamic, process-oriented features of CSPs to be revealed in ways that attend well to the central research question of my study.

A theory of collaboration that has gained prominence in the twenty-first century is Collaborative Governance Regimes (CGRs), originally conceptualized by Emerson and Nabatchi (2015) that also builds on Gray's (1989) foundational work. The CGR framework is more tailored to public governance systems and proposes three components of collaboration dynamics: 'principled engagement' which considers underlying normative assumptions about interactions, 'shared motivation' which considers underlying social assumptions about self-interests, and 'capacity for joint action' which considers organizational change that enhances their individual capacities for collaboration (Emerson & Nabatchi, 2015). The language of these components resonates well with earlier discussions on the best practices of CSPs (e.g., shared vision, developing collaborative capacities, divergence of self- and collective interests). CGRs focus on the context and dynamics of collaboration and offer an attractive proposition for making sense of how organizations change to accommodate CSPs in engineering education. However, the emphasis on the conditions under which collaborative arrangements should be formed may be less applicable to my study, a similar limitation as the antecedent-process-outcome model proposed by Wood and Gray (1991) where collaboration processes are less addressed than the inputs and outputs. Thomson and Perry (2006) propose a similar collaboration model to CGRs but seek a more balanced, multidimensional, and systematic approach to understanding collaboration processes. Their theoretical model, the *Five Dimensions of Collaboration*, proposes

a conceptualization of collaboration built on the foundations of negotiated order theory, exchange theory, and rational choice theory (Thomson, Perry, & Miller, 2007).

2.3.3 Inter-Organizational Collaboration as a Conceptual Framework

My study employs an adapted version of Thomson and Perry's (2006) conceptual model to expose study-specific features of CSPs. The original definitions from Thomson et al. (2007) for the *Five Dimensions of Collaboration* are:

> **(1) Governance**, which considers the role of each partner, decision-making, how costs and benefits are distributed, how working rules are established, and how shared responsibility is understood.
>
> **(2) Administration**, which considers administrative structures in place for each partner and the partnership, what tensions exist between self (org) and collective (partnership) interests, and the role of social networks.
>
> **(3) Organizational Autonomy**, which considers how tensions between interests are negotiated, the role of identity among partners and through partnership, and what working relationships look like.
>
> **(4) Mutuality**, which considers the role of interests (both differing and shared) and interdependency, accommodations made that enable exchange, and the common appreciation or passion for issues promoting mutuality.
>
> **(5) Norms of Reciprocity, Trust, and Reputation**, which consider the understanding of equilibrium in exchange, when and how that is achieved by partners, the role of trust and its impacts, and how 'good faith effort' shows up through the discourse.

The construct validity of their collaboration model was tested on a large sample of organizational directors with experience in inter-organizational collaboration (Thomson et al., 2007). A survey

of fifty-seven measurement items was used in their study, and evidence of validity of seventeen of those items generated empirical support for the *Five Dimensions of Collaboration* model. However, the 'norms' dimension lacked statistical support for how reciprocity in collaboration was measured in the study. Some explanation from the researchers was proceeded by the recommendation to include 'failed' collaborations in sampling (i.e., those partnerships that were viewed as unsuccessful or marginal) (Thomson et al., 2007). My research approach (as described in chapter three) is less interested in whether empirical support is provided for a conceptual model, although it does help to establish evidence of internal validity (or what I lean on as an alternative to this quality measure, conceptual coherence). Moreover, consideration of the seventeen validated items in Thomson et al.'s (2007) study is given in the data collection strategy (discussed in chapter three).

The IOC model has been adapted within a research study in engineering education that investigated public-private partnerships (Gillen et al., 2021), and another that built evidence of the model in an international context (Roberts et al., 2017). Gillen et al. (2021) developed interview protocols guided by the *Five Dimensions of Collaboration*, following Thomson et al.'s (2007) suggestion to adapt and extend the questionnaire, to measure additional and modified dimensional features appropriate to the context and situation of their study. Roberts et al. (2017) adapted and build evidence of validity of the IOC model in the South African context, demonstrating how certain dimensional features may be measured and interpreted from differing cultural (global) perspectives. Gillen et al. (2021) also adapted the model to build a stronger understanding of how best to partner with industry in an engineering capstone program. These are a few examples of where researchers in engineering education have adapted Thomson & Perry's (2006) IOC model to make sense of collaboration processes in unique contexts and

situations, and the model has also been adapted in public administration, management, policy, and governance research studies.

Veles, Carter, and Boon (2019) leveraged features of the IOC model to study 'third space professionals', or those individuals who work across boundaries in an inter-organizational partnership. The researchers were most interested in cultural aspects of IORs, integration between organizations, and the level of interaction. They found that the IOC model offered valuable insight into their investigation of IORs, also showing how the model can be used in combination with partnership continua as discussed earlier. Jackson et al. (2018) compared different manifestations of inter-organizational arrangements (firm-firm and firm-university) using the IOC model and found the most significant variation in their data occurring within the 'mutuality' dimension, demonstrating how certain dimensions may be more apparent when viewed in different partnership situations. Ansell and Gash (2017) adapted features of the model to 'collaborative platforms' that support governance strategy in public administration (like CGRs), specifically looking at interdependencies within the 'reciprocity' dimension. A study by Sedgwick (2017) used Qualitative Comparative Analysis (QCA) to compare collaborative processes within partnership activities. She found that the level of involvement (i.e., intensity of interaction) of organizations had a significant impact on the collaborative process dimensions, providing additional support for the idea that the IOC model can integrated within partnership continua (e.g., collaborative arrangements may be revealed differently than cooperative arrangements in partnerships, when viewed through the IOC model). The above examples show variation in how researchers have employed the Thomson and Perry (2006) IOC model to make sense of diverse types of partnership situations, their process dimensions, and unique features. Given the situated nature of CSPs, an adaptive approach to exploring dimensions and features of

collaborations should prove more effective than a prescriptive approach (Greer, 2017). The adaptation of Thomson and Perry's (2006) IOC model in my study follows similar thinking to these prior studies, tailoring design elements to expose certain features of CSPs in engineering education that are more readily interpreted through the storytelling of participants.

In my study, the CSP situation is assumed to provide benefit to the parties in ways that could not otherwise be achieved independently, that partnerships are formed and shaped by some level of interdependence between the parties, and that collaboration takes place primarily through social interactions. Another assumption of IOC theory is that each party has unique influence on collaboration, there is a degree of individual choice and some level of organizational autonomy that influences collaboration processes, and that there is an element of trust inherent in all collaborative arrangements. Some aspects of these assumptions are evident in the definition of collaboration employed by my study:

> "Collaboration is a process in which autonomous or semi-autonomous actors interact through formal and informal negotiation, jointly creating rules and structures governing their relationships and ways to act or decide on the issues that brought them together; it is a process involving shared norms and mutually beneficial interactions (Thomson et al., 2007, p. 25)."

Gray & Purdy (2018) suggest that a comprehensive definition of collaboration includes attention to independent actors who are unable to solve the problem unilaterally, an emergent process with shared rules and structures, constructive tension in consensus-building and negotiations, partners who bring unique competencies but also need to learn from others, and the mutual acceptance of risk and responsibility for outcomes. The more concise definition from Thomson et al. (2007) encompasses these elements well, although the verboseness of Gray and Purdy's (2018)

guidance on defining collaboration supports the following adaptation of the *Five Dimensions of Collaboration* in my study:

> **(1) Governance**: The emergent process of developing and negotiating shared rules, structures, and decision-making capacities that govern the partnership.
>
> **(2) Administration**: The implementation and management of governance structures in the partnership that includes clarifying operational mechanisms such as partner roles and communication channels.
>
> **(3) Mutuality**: The complementary exchange of resources and/or a shared commitment to a jointly established mission for the partnership where risks and responsibilities are mutually assumed.
>
> **(4) Organizational Autonomy**: The tension between each partner's individual organizational interests (self-interests) and the collective interests of the partnership.
>
> **(5) Norms of Reciprocity, Trust, and Reputation**: The perceived relative degree of obligation and evolving beliefs about each partner's commitment to the partnership.

This adaptation was influenced by a similar IOR study that employed Thomson and Perry's (2006) IOC model to study a partnership between a private-sector business, a university, and a middle school in the context of engineering education (Gillen, Grohs, Matusovich, & Kirk, 2021). The adapted framework helped guide the research design process described in chapter three. In addition to these IOC concepts that explore and explain the 'how' of partnerships, my study also brings in the concept of 'antecedents' to explore and explain the 'why' of partnerships (e.g., motivations to partner, strategies employed in partnerships), leaning on the partnership model proposed by Wood and Gray (1991) to inform the research design.

Chapter 3: Research Design

The literature review provided an overview of cross-sector partnerships (CSPs) from the perspective of their manifestations, activities, and processes, explored the history of CSPs, and described the conceptual framework that was used to guide the research design. The review showed that collaboration processes guiding CSP activities are complex and heavily situated in their unique manifestations. To illuminate these complexities, my study sought to understand the meaning-making of individuals who have experienced CSPs and to interpret the variation in their beliefs that relate to the complexities of partnering in engineering education. This chapter outlines the approach taken to address the central research question: **How do organizations outside of academia describe their experiences partnering with universities on undergraduate engineering?**

In my study, the phenomenon of interest is partnership between higher education institutions and non-academic sector organizations (i.e., organizations outside of academia, or external partners) that employ engineers on the education of undergraduate engineering students within the academic setting. My interest is in the knowledge claims that these individuals, who represent the external partners of engineering education, construct about the circumstances and processes of collaboration and within the contexts they occur, to interpret the variation in their underlying beliefs. This interest, supported by the central research question, is best suited for an interpretivist orientation to qualitative research. In this orientation, reality is acknowledged as subjective, experientially based, and local to the individual (Guba & Lincoln, 1994).

3.1 A Big-Q Qualitative Approach

There are multiple orientations that researchers take to interpretivist research. What has been discussed so far may be best captured by what Kidder and Fine (1987) called a ‘Big Q’

qualitative approach, defined by employing qualitative techniques within a qualitative paradigm. My beliefs as a researcher and how I view the CSP situation, both of which have shown up in earlier discussions (and discussed in more depth in the section on my role in the study), tend more towards a view of reality that extends beyond the individual and is created through the shared experiences of people, a relativist-leaning ontological perspective (Walther et al., 2013). From this perspective, the realities of collaborating within CSPs do not belong to any one individual but rather are constructed through partnerships and constitute multiple realities—everyone holds a different version of truth, their truth, as it relates to the partnerships. Constructivism (also referred to as constructionism in referenced literature) is a relativist epistemology that often takes a critical approach to interpretive inquiry (Braun & Clarke, 2022), viewing knowledge as created in the interactions and relationships between people (Guba & Lincoln, 2005) and experiences as mediated by history, culture, and language (Baillie, 2014). From this perspective, the knowledge claims made by participants in my study only become knowledge through their interactions with me, the researcher reporting them. The interpretative process of constructing knowledge through interaction is informed by both the participants' values, experiences, and backgrounds, and my own. The analytic task of my study becomes, then, situated in the interaction, subjective, and anti-foundational in the relativist sense that truth is what is generated from analysis (Braun & Clarke, 2022). From these perspectives on truth, knowledge, and reality, a critical-leaning, Big-Q qualitative approach to answer the central research question of my study was chosen. Grounding my study in the Big-Q approach informs an acknowledgement of limitations, considerations for my role in the study, how attention to quality is demonstrated, and the methods employed.

3.1.1 Methods Overview

A defining characteristic of qualitative research is the focus on the meaning-making of participants (Creswell & Creswell, 2017; Maxwell, 2008), locating the researcher in their world (Guba & Lincoln, 2005). The emphasis is on the situated aspects of their beliefs (Kvale & Brinkmann, 2009) to develop a complex picture of phenomena (Creswell, 2013) through their interpretations of experience. A Big-Q qualitative approach to my study thus relies on exploring the beliefs of individuals who have experienced CSPs in engineering education and with a focus on the situated aspects of their beliefs. The approach provides philosophical justification for my study design, and the methods proposed in this section are the procedures used to conduct my study (Baillie, 2014). To ensure that a qualitative study is cohesive across its design components, the methods must be interconnected and interrelated to the study's purpose and research question (Creswell, 2013; Maxwell, 2008). The methods described in this section include formal interviews as primary data and reflexive thematic analysis as the primary approach to data analysis.

A defining characteristic of qualitative research is conducting studies in natural settings (Creswell & Creswell, 2017). The research questions indicate that the 'underlying beliefs' of individuals are what was sought in my study, and there are several approaches that were considered for generating data that speak to their beliefs. Participant observation methods are often used in qualitative research and enable a researcher to observe behaviors and actions in real-time. These methods offer several advantages in naturalistic inquiry and require access to the situations in which the phenomena of interest occur. Given that CSPs tend to exist in a 'third space,' where the processes of collaboration occur across space and time, the ability to access partnerships in real-time poses significant access and logistical challenges. A more practical

approach to data collection in my study was to consider another commonly employed method in qualitative studies, interviews. Interview research offered several advantages to my study such as flexibility in space and time (i.e., could be conducted across geographical distances via online platforms, at the convenience of participants), in-depth discussions on the topics of interest, and diverse perspectives of the phenomenon through an intentional approach to representativeness across sectors (ref the sampling section).

The interest of my study was to understand the meaning-making of individuals representing external partners of engineering education, and with a critical-leaning orientation the interest was further scoped to the underlying beliefs participants held about partnerships (not necessarily to reflect in analysis what they said, but how their interpretations connect to the issues and through the experiences in which they were interpreted). The analytic task being situated, subjective, and anti-foundational was best suited for a reflexive, theory-informed approach to data analysis. Thematic analysis is a commonly used method in qualitative research (Guest et al., 2012) and supported the critical-leaning, Big-Q approach I employed to address the research questions in my study. There are many approaches to thematic analysis (TA) and studies tend to follow one of three common types: (1) a codebook approach, (2) a coding reliability approach, or (3) a reflexive approach (Braun & Clarke, 2022). One of the most common TA approaches employed in both a codebook and coding reliability method is Applied Thematic Analysis (ATA) (Guest et al., 2012). This approach incorporates inductive analysis of data (though not always or entirely atheoretical), employs systematic procedures for coding and theme development, and emphasizes a descriptive and exploratory orientation to data. However, Braun and Clarke (2022) suggest that these types of approaches often fall short of a Big-Q approach through their emphasis on following procedures closely, reducing data, achieving

consensus among coders, and reporting accuracies. A reflexive approach to TA is suggested by Braun and Clarke (2022) for studies that are conducted within the Big-Q framework.

Reflexive Thematic Analysis (RTA) is a widely employed qualitative research method that can be used for both inductive and deductive orientations to data (Braun & Clarke, 2013). A few key issues that distinguish RTA from ATA (and other) forms of TA include accessibility (learn while doing), recognizing theory as something active rather than separate and abstract, analysis that moves beyond summaries and data reduction conventions, themes that are generated (not 'emerging') from data, and a solid grounding in qualitative values and the Big-Q (relativist/constructivist) approach (Braun & Clarke, 2022). RTA involves systematic processes to develop, analyze, and interpret patterns of meaning across qualitative datasets. The processes are not tightly prescribed but rather offer a set of tools (practices, guidelines, and techniques) to organize, interrogate, and interpret data. Braun and Clarke's RTA resources (2013, 2022) offer practical guidance on doing TA in a way that is creative and reflexive. Their approach emphasizes theoretical and analytical flexibility, emergent design and pragmatic decision-making, and research quality judgement and considerations throughout all phases of RTA.

3.1.3 My Positionality and Role in this Study

My role in my study was that of a storyteller—creating an analytic narrative that provided an answer to the central research question using a variety of tools, techniques, and resources that were available to me (Braun & Clarke, 2022). As a storyteller in interpretive research, it is important to provide a reader with a sense of personal beliefs, values, and experiences related to the phenomenon of interest in my study. I have worked on both sides of CSPs—as an academic professional with experience partnering with external businesses on undergraduate engineering education, and as an industry professional with experience partnering with universities on

undergraduate engineering education. My experiences in CSPs were limited in scope and time (only a few activity types, and only over a few years) but led to my interest in this study, and broader interests in the 'third space' of partnerships between HEIs and non-academic sector organizations. Third space professionals work at the crossroads of organizational boundaries, are uniquely exposed to seeing the connections between activities, and more appropriately situated to notice opportunities where collaboration can happen in pursuit of shared interests and goals (Veles et al., 2020). My experiences, skills, and interests resonate with this third space (boundary-spanning, as discussed in the literature review) of engineering education. I recognize that my beliefs, values, and experiences shape how I make decisions in my study and my interpretations of the data. What I care most about in CSP situations is the impact on students' learning. I believe that enhancing CSPs in engineering education can create positive impacts on students' learning and professional development. I lean into this subjectivity as a resource rather than a source of bias that should be mitigated. In this section, I acknowledge broad assumptions and beliefs related to the education-specific CSP situation and the interpretive lens I used to construct an analytic narrative around the data I collected and analyzed.

I reject the idea of an objective and unbiased scientist, consistent with my values and critical orientation to qualitative research (Creswell, 2013), and the ontological and epistemological assumptions described in the introduction to this chapter. My intention in this discussion is to demonstrate an evolving qualitative sensibility, or what Walther and colleagues (2013) refer to as interpretive awareness, in the interest of articulating my beliefs, values and assumptions, and interrogating their potential influence on the study (Braun & Clarke, 2013, 2022). This sensibility does not assume I could simply 'bracket off' my assumptions and pre-conceived notions so that they would have less effect. The non-dualism of interpretive research

makes neutrality impossible (Walther et al., 2013). Instead, I took a critical approach to the decisions made throughout my study and reported on the decision-making process with transparency. This discussion on self-reporting is not limited to this section and is particularly relevant in data analysis where reflexive techniques are employed to enhance the overall research quality. Maxwell (2008) suggests that explicit discussion of the identities and experiences of the researcher has theoretical and philosophical support. The discussion of researcher identities is also suggested by Braun & Clarke (2013, 2022), whose work on RTA I leaned on throughout the data analysis. My qualitative sensibility included an orientation to a 'critical subjectivity' where raising evidence to consciousness and incorporating subjectivity into the inquiry process are recognized as important practices (Maxwell, 2008; Lincoln, 1995), using techniques such as reflexive journaling (discussed in the section on complementary data sources).

Secules and colleagues (2020) suggest that positionality statements may help to capture the ways a researcher is defined by 'socially significant' identity dimensions and are used to bring forward and interrogate inherent power dynamics. My social identities as a white, cis-gender male may have had bearing on my relationship with participants and audiences in ways I was not able to predict. My identities as a mid-career professional and veteran of the U.S. armed forces may have also influenced my decision-making and interpretations or how readers perceive my work. I could fully predict how these identities would influence my study, but what I could do was acknowledge and interrogate where these influences may have showed up. I interviewed industry professionals who may share certain identities that I claim, such as my identity as an engineer, given that most of my participants indicated they had an engineering background. These shared identities may have helped me to establish rapport and solidarity with participants, and enriched conversations, but may also have led to me "siding with" participants rather than

keeping a more neutral position in what Kvale and Brinkmann (2009) refer to as 'going native.' I also chose a specific theoretical lens through which to interpret data (the adapted IOC model discussed in chapter two), and this decision, although reasoned in the literature review, is reflective of my values and experiences with CSPs in engineering education. I acknowledge that the IOC framework is not the only way to make sense of CSPs in engineering education. It is the approach I chose, through theoretical and literary-informed reasoning, but a choice nonetheless which may carry certain connotations. My qualitative sensibility in this regard was to include inductive approaches to data analysis (as complementary to the primary deductive approaches) to interrogate the theoretical constructs I was working with and ensuring a more neutral orientation to the analytic process was considered alongside the theoretical orientation. These are just a few of the decisions I made in my study and as mentioned earlier, reflexivity and maintaining a qualitative sensibility was integral to all processes in my study.

3.2 Data Collection Strategy

Consistent with the Big-Q qualitative approach, my study employed a strategy for collecting data that I felt best addressed the research question within the constraints imposed by the scope and scale of my study. Developing this strategy required creativity and a qualitative sensibility to translate the research questions into design methods (Maxwell, 2008). As discussed in the literature review, the activities of CSPs tend to happen within a third space of partnership where decision-making, establishing goals, and related processes take place over time and through variable communication types. Each manifestation of a CSP is also assumed to reveal distinct types of activities and processes, making it challenging to develop a data collection strategy with direct observation of the phenomena across multiple situations. Interview research was used in my study as it enabled data collection outside of the time and space constraints of

direct observation (Hatch, 2002). Discussions follow on my sampling strategy and how the interview method was designed for my study in a way that best served the study purpose.

3.2.1 Formal Interviews as Primary Data

Leaning on the Big-Q approach of my study, I employed formal, semi-structured interviews to collect data to address my central research question. I was interested in the kinds of mental maps that individuals who represent external partners carry in their minds that relate to their experiences with CSPs, to help me co-construct knowledge and co-develop insight into the antecedents and collaboration processes that underpin partnerships. As recommended by Hatch (2002) and Creswell (2013), I used brief, open-ended questions to stimulate participants to articulate their mental maps, using the interview protocol in Appendix A. The key outcomes of interviewing these individuals were knowledge and insight relevant to 'here and now' constructions (their explanations of current involvement in CSP activities and their feelings about them), reconstructions (their explanations of what they've experienced in the past), and projections (their explanations of what they anticipate will happen in the future) (Hatch, 2002). Although reconstructions of experiences were of primary interest to my study, it was also important to bring in any relevant ideas from present experiences and future expectations. The section on the interview process gets more in-depth into these design strategies for interviews, although another outcome desirable in qualitative research is to extend or verify information gathered through interviews using multiple data sources (Hatch, 2002).

3.2.2 Complementary Data Sources

To support overall research quality, many qualitative researchers seek a variety of data sources that may verify information in data collection or validate concepts and theories in analysis (Creswell, 2013) through a technique called triangulation (Shenton, 2004; Creswell &

Creswell, 2017; Maxwell, 2008; Guest et al., 2012). As mentioned in the introduction to this chapter, my study instead leaned on an alternative technique called 'crystallization' where the goals were less about multiple data sources, and more about openness to a complex and in-depth understanding of phenomena through data available (Tracy, 2010). This type of thinking, consistent with my pursuit of demonstrating a qualitative sensibility, led to a reconceptualization of secondary or triangulation data sources as complementary data sources (rather than 'secondary' data sources). In other words, my study did not seek to leverage data beyond interviews explicitly for the purpose of verifying information or validating concepts, but rather I was open to opportunities to collect and analyze data complementary to the interview data. Braun and Clarke (2022) recommend taking advantage of emergent opportunities to collect and analyze data relevant to the phenomenon of interest where they connect to the storytelling of participants. I initially speculated that some participants would point to publicly available (or accessible through approved channels) information such as news articles, partnership agreements, social media posts, or other tangible or intangible data sources that provided complementary information to their narratives. However, those opportunities did not present themselves enough to further explore their utility in analysis. Thus, the only complementary data source that was explicitly used for these purposes was my reflexive journal, although several sources of input were used to crystallize evolving ideas about the data in the analysis procedures.

Reflexive Journaling. A core assumption of interpretive inquiry is that reflexivity is key to quality analysis (i.e., researchers 'own' their perspectives) (Braun & Clarke, 2022). Some scholars recommend journaling as a reflexivity tool to make sense of the research and journey (Creswell & Creswell, 2017; Hatch, 2002), which also becomes an important complementary data source for analysis (Braun & Clarke, 2022). My intention was to incorporate reflexive

thinking into the process of research by keeping detailed notes on my subjective experiences, observations of the process, questions, concerns, hunches, etc. (Creswell & Creswell, 2017). A reflexive journal supports keeping a documented self-critical account of the research process, a space to question and push oneself (not just record thoughts), and an opportunity to develop a qualitative sensibility (Braun & Clarke, 2022) through reflection throughout a study. Specific to interviews, Hatch (2002) recommends using journaling to note impressions about the interviewee and their reactions to questions, reflect on the interview events, judge the quality of the interview questions and process, and self-critique performance of interviewing participants. Hatch (2002) suggests making journal entries right after the interview and then again after transcribing them. Braun & Clarke (2022) suggest making entries even before data collection to capture early analytic thoughts so they may be recognized and interrogated later, supporting a thoughtful and creative approach to engagement with the entire research process. These scholars also suggest that journaling helps to reveal new and alternative interpretative possibilities in data analysis and encourages an ongoing, embedded process of reflection on assumptions.

As to 'how' to make journal entries, Braun & Clarke (2022) suggest a few practical approaches such as mixing both 'superficial' (mundane and pragmatic) thinking-type entries with more nuanced accounts of my journey such as challenges, doubts, outstanding questions, and evolving insights into what is happening in the phenomenon. They also suggest entries that reflect prior knowledge about the phenomena and being intentional to document how this knowledge evolves throughout the journey. I leveraged a combination of these reflexive techniques throughout my study, detailed throughout the subsequent sections. Some of my initial entries were reflections on my background, goals for the research, assumptions about what I would discover, and how my design choices might impact what my study could reveal about the

phenomenon of partnerships in engineering education. An example journal entry is provided in Appendix B. Turning the attention to sampling, one journal entry captured the following reflection: “The types of people that I really want to talk to about partnerships are the ones whose identities extend beyond their employers, beyond their industry, and beyond their own self-interests… People who must constantly negotiate, advocate, and justify what their work means for their employer, for their partner institutions, and for the benefit of student learning… They are the true boundary workers I am most interested in learning from.”

3.2.3 Purposeful Sampling

Creswell (2013) suggests that a hallmark of qualitative research is reporting multiple perspectives representative of the larger population and relevant to the research question. The intent of sampling is to build towards representativeness of the settings in which the phenomena exist (Maxwell, 2008) and capture the heterogeneity in the population under study. The desired outcome of sampling is that conclusions drawn from a qualitative research study represent the range of variation in the phenomena, a situation best suited for a purposeful sampling approach to data collection (Maxwell, 2008). This type of sampling seeks participants who have insight relevant to the phenomenon and research questions (Braun & Clarke, 2022) and requires decisions on criteria for who can provide this representativeness, how their perspectives may fall along the spectrum, and how many participants are needed to ensure sufficient coverage (Creswell, 2013). A tradeoff to the advantage of diversity in representation is the challenge to find commonality among experiences to ascertain an overall essence of the phenomena for all participants (Creswell, 2013). This tension is why careful consideration for sampling criteria, and a thoughtful recruiting strategy were uniquely important for my study, given the expected variation in characteristics of individuals who represent external partners of engineering

education. It would not have been advantageous to have a sample heavily skewed towards one CSP activity type such as capstones, in which case the findings would only be relevant and applicable to that unique activity type.

Sampling Criteria and Strategy. Building up to this point in the research design process, the inputs to making decisions about sampling included the focus on external partners of engineering education (e.g., private, for-profit businesses, non-profit organizations, federal- and state-run organizations), the representativeness across organization types (sectors) that participate in CSPs, the 'third space' of partnerships (i.e., partnership intermediaries or 'champion' perspectives), and the variation in perspectives that cover the spectrum of CSPs manifestations of interest in my study. These inputs led me to the following decisions about sampling criteria:

(1) Participants must be individual representatives of their employers, whose responsibilities include managing partnership activity with universities specific to engineering education (i.e., they are 'champions' of university partnership activity on behalf of their employer).

(2) Participants' employers, collectively, must represent the range of common non-academic sectors that partner with universities on activities specific to engineering education (i.e., a diverse mix of U.S. public and private sector organizations).

(3) Participant employers' involvement in partnerships with universities, collectively, must represent the range of common partnership activity types (i.e., a mix of capstone and other project-based sponsorship, advisory board participation, guest speaking engagements, etc.) commonly found in U.S. public, land-grant universities.

These core criteria guided my sampling strategy, seeking individual 'champion' participants, representing a range of organization types and involvements in engineering education, described in more detail in a subsequent section on recruiting participants. Given the range of institution types that may be classified as 'engineering education' (i.e., universities that offer four-year degree programs in engineering), I added an additional element to the 'partnership activity type' criterion for seeking individuals that could speak to partnership experiences with 'U.S. public, land-grant' institution types. This scoping decision was made because of the expected variation in participant perspectives for different institution types (i.e., how they felt about working with private institutions was likely to differ from how they felt about working with public institutions), and the expected variation in perspectives across international contexts (i.e., perspectives specific to working with U.S. institutions were likely to differ from non-U.S. institutions). I chose the 'public, land-grant' type for my study because these institution types serve a large portion of the undergraduate engineering population in the United States. These decisions and their impacts on the study findings are discussed further in chapter five.

Sample Size. A challenging task for my study was deciding on a sample size that would provide an insightful, rich, data-informed answer to the central research question, keeping in mind practical considerations for a dissertation study. Researchers suggest that interview research of this nature (qualitative, person-to-person, formal) typically includes around 5-25 participants, and most advocate that dependencies for sample size include study purpose, goals, and scale (Braun & Clarke, 2013, 2022; Kvale & Brinkmann, 2009; Hatch, 2002). Given the sampling criteria for achieving representativeness across non-academic sectors, I decided that my sample should include half private-sector organizations and half public-sector organizations. I

define ‘private sector’ as those organizations whose mission serves private interests and ‘public sector’ as those organizations whose mission serves public (local, state, or federal) interests. To ensure that each of those sectors included sufficient coverage of CSP activity types, per the sampling criteria for achieving representatives across those activity types, I decided on a total sample size of approximately 20 participants who represent unique organizations.

3.2.4 Recruiting Study Participants

With the sampling criteria and desired sample size in mind, I set out to recruit my study participants. The intention of discussing a recruiting strategy in my study is to articulate my process for identifying potential interviewees who could best provide insight into the research questions, based on the sampling strategy mentioned above (Creswell, 2013). The challenges with recruitment for interview research include identifying and contacting potential participants, gaining their fully informed consent, coordination of arranging times for the interview events, managing the process in an organized manner, and ensuring professional courtesies are extended to the participants (Hatch, 2002). The general population of interest (individual representatives of non-academic organizations who partner with universities on engineering education) was not readily identified through publicly available information sources. These types of individuals are unique to the situations in which they come to be known as part of the population. Identifying them was a continuous process of leveraging professional connections, networks, and snowballing (i.e., participants recommend others). The final sample is shown in Table 1.

Table 1. Study Participants

Person	Rank	Primary Role	NAICS	Description	Size	Classification
Josiah	Manager	University R&D	33312	Machinery Manufacturing	Large	Private, For-Profit
Violet	Manager	Talent Acquisition	22111	Electric Power Generation	Large	Private, For-Profit
Ramon	Executive	Business Management	42399	Durable Goods Merchant	Large	Private, For-Profit
Dustin	Director	Eng. Management	33521	Electrical Appliance Manu.	Large	Private, For-Profit
Haven	Manager	Internal R&D	54171	R&D in Phys., Eng., Life Sci.	Medium	Private, For-Profit
Aarav	Manager	Internal L&D	51121	Software Publishers	Large	Private, For-Profit
Doug	Director	University Partnerships	33611	Auto. & Light Veh. Manu.	Large	Private, For-Profit
Aniya	Manager	Talent Acquisition	33361	Turbine & Generator Manu.	Large	Private, For-Profit
Carla	Manager	University Projects	62412	Services, Elderly & Disabilities	Small	Private, Non-Profit
Julie	Executive	Business Management	62412	Services, Elderly & Disabilities	Small	Private, Non-Profit
Alex	Executive	Eng. Management	33641	Aerospace Product Manu.	Large	Private Defense Contractor
Byron	Manager	Eng. Management	33641	Aerospace Product Manu.	Large	Private Defense Contractor
Joey	Manager	University Partnerships	54171	R&D in Phys., Eng., Life Sci.	Medium	Private Defense Contractor
Micah	Executive	Business Management	33641	Aerospace Product Manu.	Large	Private Defense Contractor
Kyler	Executive	Business Management	33641	Aerospace Product Manu.	Medium	Public, Federally-Funded
Caleb	Manager	University Partnerships	54171	R&D in Phys., Eng., Life Sci.	Medium	Public, Federally-Funded
Mila	Director	University R&D	33641	Aerospace Product Manu.	Medium	Public, Federally-Funded
Kevin	Executive	Internal R&D	54171	R&D in Phys., Eng., Life Sci.	Large	Public, Federally-Funded
Sonny	Director	University Partnerships	92811	National Security	Medium	Public, Federally-Funded
Denver	Director	Org. Partnerships	33441	Semiconductor Manu.	Small	Public, State-Funded

My sample demonstrates a strong mix of both private and public sector organizations, further granularized into four categories: (1) private, for-profit, (2) private, non-profit, (3) private defense contractor, and (4) public (federally- or state-funded). The thinking behind separating out ‘defense contractors’ (i.e., a significant portion of the business is aligned to DoD interests) was to explore how these specific private, for-profit types show alignment to public-serving interests or otherwise demonstrate variation, per the last research question. The classifications were made using a combination of publicly available information sources such as the U.S. Census Bureau (Census.gov) and System for Award Management (SAM.gov) databases. I assigned aliases in place of participant names to protect their identities, and broad terminology is used for ‘rank’ and ‘primary role’ to protect participants’ professional titles and roles in their organizations. The names of the organizations are protected by providing NAICS (North American Industry Classification System) codes and descriptions using the NAICS.com search engine. I chose to use five-digit NAICS codes to ensure a balance between desired anonymity and providing descriptions of organizations to my target audience. The company size was

determined using a combination of employee counts and total revenue (e.g., a 'Medium' sized company has 100-999 employees or $10 million to $1 billion in total annual revenue for tax year 2023), sourced from the Securities and Exchange Commission (SEC.gov) and the Bureau of Labor Statistics (BLS.gov) public databases.

An intended audience of my study is university professionals (faculty, staff, and administrators) who have experience partnering with businesses and government-run organizations on engineering education. This population was more accessible for identifying potential study participants. These types of individuals include capstone coordinators, department administrators, student club advisors, institute staff that work with external partners, and faculty who have multi-faceted partnerships with non-academic organizations (typically centered around sponsored and collaborative research) that include educational components. The networks of these university professionals, in the greater engineering education community, were invaluable in supporting the recruitment of participants for my study. Before contact was made with potential participants to request participation in my study interview, a key step in this process was to first obtain approval from my university's Institutional Review Board (IRB) to conduct my study.

3.2.5 Interview Process

In my study, participants were provided with the IRB-approved consent form ahead of scheduling interviews and verbally agreed to participate at the start of the interview. Following approved IRB procedures, I used email for initial correspondence with participants. Several participants requested phone calls or initial teleconference meetings to discuss my study before deciding to participate. Email correspondence was also used to confirm interview appointments and follow-ups. Consistent with the recommendation from Creswell (2013) to conduct pilot

testing, to refine the interview questions and procedures, I conducted a pilot interview with a professional colleague who met the sampling criteria. The pilot interview is not included in the final dataset. The final interview protocol, refined by the pilot interview, can be found in Appendix A. Developing the questions in the interview protocol leaned on an approach described by Luker (2008). I wrote down every question that I might want an answer to and created clusters out of those questions based on similarity in topics that related to my research questions. For each cluster, I arranged the questions to match natural language (creating a conversation) and then arranged the clusters to develop a conversation outline with transitions between each cluster. I reflected on which clusters and questions were most important to answering my central research question and highlighted them. This step was heavily influenced by the seventeen validated items from Thomson et al.'s (2007) study, creatively aligning my thinking about interview questions with the theoretical constructs and the authors' approach to developing questions around them. I then leaned on Hatch's (2002) suggestions to ensure open-ended formatting and language that would be familiar to participants, refining the questions so that they were clear and neutral. As a last step, I leaned on Kvale and Brinkmann's (2009) guidance to ensure questions were brief, simple, and distinguished in purpose (e.g., drafting follow up questions, probing questions, and direct and indirect questions).

It was not intended that every question on the protocol would be asked (or answered) in an interview but rather the thoughtfully organized collection of questions provided guidance on primary topics of interest and potential secondary questions that could be asked to probe further into the interviewees' storytelling. Hatch (2002) recommends only using a select few broad questions that stimulate interviewees to talk about certain topics but allowing their stories to be told with minimal imposition from the interviewer. Luker (2008), Hatch (2002), Creswell (2013),

Braun and Clarke (2013), and Kvale and Brinkmann (2009) all recommend a 'ramping of intensity' for ordering interview questions with initial questions getting at the participants' experiences at a surface or concrete level (e.g., describe the situations in which they participate in UIPs) and trailing questions to provide a 'cool down' phase that allows participants to get back to a more emotionally detached place. These ideas were all influential in developing the questions and the interview protocol I used in my study. The general format of the one-hour individual interview discussions was as follows:

(1) The participants' current role and responsibilities, especially those specific to university activity, and their professional background.

(2) A university partnership experience that the participant felt 'went well,' with probing questions aligned to the process dimensions of IOC theory.

(3) A university partnership experience that the participant felt 'did not go well,' with probing questions aligned to the process dimensions of IOC theory.

(4) Any changes or impacts to how participants work with university partners because of major societal, economic, or political events in recent years (e.g., COVID, federal policy changes).

(5) The participants' advice, big ideas, or suggestions to universities and other non-academic sector organizations for pursuing, forming, managing, or sustaining partnerships.

This format enabled the 'ramping up and down' of intensity in the conversation, starting with casual conversation focused on the participant, then more intense dialogue around the participants' experiences, and then wrapping up by giving participants freedom to express their ideas about partnerships. The dyad approach to the experience topics was inspired by the

literature review (e.g., best practices versus challenges in chapter two), also supporting the intention to paint a more complete picture of process dimensions through both positive and negative sentiments. There were also questions asked in the interview (see interview protocol in Appendix A) that dealt with a sixth dimension of IOC theory. This dimension, individual autonomy, was added because of my initial speculation that personal factors (i.e., not just the organizational self-interests, but the individual or personal interests) may have an impact on partnerships. Although some aspects of individual motivation as driving organizational partnerships were evident (see chapter four discussion on 'motivation to partner'), there were insufficient data to support including this sixth dimension in my results. The interview protocol also indicates that I asked questions about the impacts of economic or political events on partnerships. However, there were insufficient data to support including related insights in my findings. These outcomes of the research process are discussed further in chapter five.

Kvale and Brinkmann (2009) propose a set of criteria to judge the trustworthiness and reliability of participant responses in interview research: the extent of spontaneous and relevant answers, the extent of long answers that follow short questions, the degree to which the interviewer clarifies the meaning of relevant answers, the ability of the interviewer to develop interpretations and verify them throughout the interview, and the interview as being 'self-reported' (i.e., requires little additional explanation for sense-making of the content). The guidance relevant to my study were to ensure I was both actively engaged in discussions but also taking notes throughout to inform a developing set of interpretations, adjusting probing questions on-the-fly in attempt to verify those interpretations and explore participants' understandings. These notes, also referred to as memos, became additional data sources for the analysis (Braun & Clarke, 2022; Walther et al., 2013). Hatch (2002), Luker (2008), and Kvale and Brinkmann

(2009) all agree that an interviewer should refrain (or minimize) asking 'why' as part of the interview since the task of the researcher is to evaluate beyond the participants' self-understanding. All these scholars also agree that the interviewer should 'let them talk' (the interviewee) as much as possible since the researcher may only have hunches about how participants' mental maps are arranged, and a desired outcome of the interview is to discover 'spontaneous' patterns of theoretical interest (i.e., seeing the theoretical concepts as understood through the perspective of the participants, which may differ from my pre-conceived notions). Luker (2008) provides guidance on this discovery process, suggesting that the interviewer can recognize 'new' ideas, topics, and concepts by listening and looking for repeated expressions and ideas, emotional agitations, and unexpected expressive language. I acknowledge that as a beginner researcher my skills are limited, and I may have missed some of these indicators during the interviews. However, Braun & Clarke's (2022) RTA approach to data analysis includes processes of iterative and systematic re-engagement with the original data (in this case, the recording of the interview audio and not just the transcripts) that helped me to catch these indicators after the interview events. These techniques helped to develop a rich, nuanced dataset that supported finding tensions and contradictions (discussed in the analysis section) and attends well to the procedural validity of my study (Walther et al., 2013). There are many other tips and best practices recommended by the scholars referenced in this section for conducting interviews that were influential to my approach and are demonstrated in the interview protocol in Appendix A, but another important topic to discuss in this section is what happened after the formal interviews.

3.2.6 Transcribing Interviews

Following each interview, Luker (2008) recommends that the interviewers make journal entries on their reflections and impressions of the interview event, speculating ideas relevant to their research questions. I followed their guidance and made entries in my journal often throughout the process and including immediately following each interview. Luker (2008) also recommends making notes about which questions worked well, and which ones may need to be refined, and assessing the overall protocol in case adjustments may be needed before the next interview. This process supported my continuous refinement and tailoring of questions in each interview, exemplified by the journal entry shown in Appendix B. Walther and colleagues (2013) suggest this type of reflexive documentation supports the dependability of the interpretive process and Braun and Clarke (2022) propose that these types of reflexive journal entries are particularly valuable to the analytic tasks that follow the data collection.

Transcription shifts the verbal conversation to a more abstracted, written form (Kvale & Brinkmann, 2009; Braun & Clarke, 2013), transforming the oral form of language to a written one. A consequence of this transformation is the loss of tone of voice, intonations, and other social elements that decontextualize oral conversation (Kvale & Brinkmann, 2009). The transcript becomes a representation of the conversation rather than a facsimile (Braun & Clarke, 2013). This transformation is a significant limitation for linguistic and conversational analyses where emotional responses are more important, although Braun & Clarke (2022) suggest that RTA is less concerned with these types of conversational surface elements in the analysis phase. They recommend an orthographic approach to transcription which focuses on spoken words and sounds and excludes phonetics (Braun & Clarke, 2013). Hatch (2002) recommends that the interviews be transcribed as early as possible following the interview event. I used the Zoom and

Microsoft Teams platforms to conduct my recorded interviews, and the built-in features for automated transcription (following my IRB-approved procedures for handling data). This first-pass transcription provided a baseline of text that was refined through close listening to the audio recordings, adjusting the transcripts as needed for accuracy. Most scholars suggest that what may be most important in this process is ensuring high quality data recording so that the transcripts can reflect, as best as possible, the realities of the oral conversation (e.g., normal speech which often includes broken sentence structures) (Walther et al., 2013; Braun & Clarke, 2013; Kvale & Brinkmann, 2009). High quality recordings also support the process-reliability of the study (Walther et al., 2013). All the interviews in my study were recorded with high-quality audio, ensuring the transcripts accurately reflected the spoken words and sounds of the participants.

Anonymizing and Storing Transcripts. To ensure the confidentiality of participants in my study, I anonymized the interview transcripts following IRB-approved procedures. I replaced the names of the participants with pseudonyms (aliases), the names of individuals they mentioned, and the names of organizational entities they mentioned (e.g., the company they work for and universities they partner with). My process was to start with a Named-Entity Recognition (NER) approach using *spaCy EntityRecognizer* (spacy.io/api/entityrecognizer), a Natural Language Processing (NLP) software library (using Python) that identified and classified personally-identifiable information (PII), replaced the PII with pseudonyms (e.g., 'ORG 2' in place of a named organizational entity), and constructed a look-up table (key-value pairs) for referencing the original information. I then made another pass through the transcripts, manually refining the anonymized transcripts and lookup tables for accuracy. Following IRB procedures, all data were handled and stored in approved virtual repositories.

3.3 Data Analysis Procedures

Consistent with the Big-Q qualitative approach, my study leaned on the assumption that interpretation in analysis happens not linearly or just at a single point of time but iteratively, progressively, and recursively throughout a study. Interpretation is part of the analytic process and embedded in the outcomes of the process (Braun & Clarke, 2022) and happens through decision-making in the research design and simultaneously with data collection (Maxwell, 2008). In this sense, some aspects of data analysis took place before the formal analysis phases (e.g., starting a reflexive journal, anchoring on paradigmatic orientations, and developing a data collection strategy), and this section is devoted to the explicit methods of 'handling the data' (Walther et al., 2013). My interest was in the meaning-making of participants who provided insight into the research questions, and my analysis was also a meaning-making process at the intersection of my approach, my positionality, the dataset, and the contexts through which the data were developed (e.g., the interview events). Which aspects of these process elements were most important in my study were informed by my central research question: **How do organizations outside of academia describe their experiences partnering with universities on undergraduate engineering?**

My study emphasized reflexivity, and I strived to demonstrate a qualitative sensibility in my decision-making throughout the research design. Qualitative analysis is not a 'production line', but a creative process (Braun & Clarke, 2013) that also considers how the outcomes of the process help to establish validity and reliability (Walther et al., 2013) for readers and the scientific community. My decisions were documented, reflexively, to support the dependability of the interpretive process (Walther et al., 2013), including a clear audit trail (e.g., documentation of the coding and the theme development processes) to support process reliability (Walther et al.,

2013). The primary method of data analysis in my study was a six-phase approach defined by Braun and Clarke (2022) for reflexive thematic analysis (RTA):

Phase 1. Data familiarization.

Phase 2. Generating codes and initial (candidate) themes.

Phase 3. Reviewing themes through re-engagement with coded data.

Phase 4. Reviewing themes through re-engagement with the entire dataset.

Phase 5. Refining and defining themes around their core focus.

Phase 6. Weaving together an analytic narrative to tell a coherent story about the dataset.

Braun and Clarke's (2022) phased approach offers guidelines, not rules, for an analytic process that emphasizes an iterative, progressive, and recursive approach to working with (interpreting) a qualitative dataset. The approach emphasizes rigor through multiple cycles of engagement with data and exploring the data beyond obvious (i.e., surface level) meaning and content and provides a structured approach to thematic analysis with deep consideration towards reflexivity and creativity.

3.3.1 Data Familiarization

The first phase of Braun and Clarke's (2022) RTA approach that I followed involved developing a deep and intimate knowledge of the dataset, critically engaging with it through both immersion (close reading) and general impression (distant or aggregative reading), and recording thoughts (e.g., memos). Braun and Clarke (2013) recommend taking an interpretive position on data familiarization through what they call an 'analytic sensibility,' to notice connections between the dataset and theory, literature, and the broader contexts in which the data are represented. Analytic sensibility involves interpreting data through a theoretical lens and producing insights that extend beyond what is obvious (Braun & Clarke, 2013). This step was

consistent with the Big-Q approach described in the introduction to this chapter that positions my study as taking a critical and (primarily) deductive approach to interpretation. I approached my data through a lens of collaboration theory (as discussed in the literature review) and actively, critically, and analytically engaged with the interview data. In this phase I also leveraged note-making (memos) to reflect on theory, facilitate my thinking about the relationships in data, and to stimulate ideas about what the data reflected to me (Maxwell, 2008). Braun and Clarke (2022) suggest a series of questions to use in this phase to stimulate ideas, attending to how participants are making sense of things, why, and in what ways, how I might feel in their situation, assumptions implicit in their responses, and what nature of reality is revealed to me. My evolving questions about the dataset were captured in journal entries throughout this phase of immersion in data and inspired ideas for how I would develop codes, themes, findings, and conclusions. The general assumption in this phase of RTA is that through immersion in data that deeper, richer, and more nuanced insights may be developed later and support the process of coding (Braun & Clarke, 2022).

3.3.2 Coding Process

A core assumption of RTA is that codes and themes result from immersion and time (Braun & Clarke, 2013, 2021, 2022). The idea is that coding improves through repeated engagement with data throughout analysis phases (Braun & Clarke, 2021). Maxwell (2008), Guest et al. (2012), and Creswell and Creswell (2017) propose that the goal of coding is to fracture, reduce, and reorganize data so that comparisons can be made across an emergent categorization of data. This type of thinking often leads to a critique of coding (and thematic analysis) as being reductionist (Saldaña, 2021; Braun & Clarke, 2022) and only offering semantic-level insights into meaning related to phenomena. The critical orientation to qualitative

research employed by my study, however, views coding as heuristic, exploring the data without seeking to 'reduce' them (Saldaña, 2021) and emphasizing a systematic and balanced approach that also considers latent meanings in the data (Braun & Clarke, 2022). My attention to quality in this phase was to capture the complexity of patterns of meaning, which included contradictions to theory, supporting theoretical validity (Walther et al., 2013). How I conducted coding in my study reflected my abilities, critical orientation to data, and attention to research quality (i.e., how I deal with potential threats to validity and reliability). As a beginner researcher, I recognized it would take practice, repetition, and diligence to code through my dataset.

My coding process was three full cycles of coding, iteratively improving and refining my approach, code labels, memos, and ideas for theme development. For example, in my first-pass coding, I applied the semantic code ‘funding projects varies by institution and program’ to Carla’s comment that “partnerships vary in terms of support… some don’t charge us, and some (charge us) a regular fee.” By the third pass, I had refined the code label as ‘context-dependent structure,’ a more latent interpretation that also enabled similar ideas from other participants to be grouped under that code label. This process, continuing with the example, also inspired ideas about how participants described pain points in working with structures defined by their university partners such as costs, resources, and expectations for involvement in student projects. In the later deductive phase of grouping codes under distinct theoretical constructs, this code was placed within the ‘governance’ dimension of IOC theory (see chapter four for the full work-up on the idea of ‘context-dependent structure’). Braun and Clarke (2022) propose a method for coding qualitative datasets that involves applying code labels to data segments based on distinct types of codes (e.g., semantic versus latent codes), although I branched off from their approach in this phase and leaned on techniques proposed by Saldaña (2021). This choice was driven by

my interest in developing a codebook to support the analytic process, rather than relying on the process preferred by Braun and Clarke (2022)—coding directly on dataset artifacts without the use of a codebook. As a beginner researcher, adding structure to the coding process supported developing more detailed outputs than what I could otherwise accomplish through less-structured techniques (Saldaña, 2021). This decision was also consistent with my pursuit of demonstrating a qualitative sensibility. Braun and Clarke (2022) make clear, throughout their descriptions of RTA procedures, that researchers should depart from the six-phase approach, as needed, to best align with research goals and the researcher's skills.

My coding approach included seeking both semantic and latent meanings in the dataset (i.e., the interview transcripts and complementary data sources), through both inductive and deductive techniques. The goal of this approach was to generate a theory-oriented (deductive) take on the data that also considered what the data revealed to me beyond theoretical explanations provided by the adapted *Five Dimensions of Collaboration* framework. To put this strategy in perspective, I did not originally intend to ask the first research question about antecedents to partnerships. However, insights relevant to antecedents came through strongly enough in my analysis that I started to pay attention to those data, eventually recognizing their utility in addressing my central research question. I attribute this discovery (discussed more in chapter five) to my analysis strategy of combining deductive and inductive coding techniques. I conducted all coding within *ATLAS.ti* (atlasti.com), a popular software tool for qualitative data analysis. This tool allowed for structured yet flexible engagement with the dataset throughout the initial phases of my analysis. As I moved further along in theme development, I branched out from the software tool and used spreadsheets for more creative freedom and flexibility than what *ATLAS.ti* could provide me.

One of the challenges of a sole researcher conducting qualitative data analyses is limited interpretation of data. How I identified and interpreted a unique idea within a participants' storytelling and assigned a code label to that idea is likely to be different than any other researcher. Other researchers may have 'seen' ideas that I did not, or they might have thought about them in a different way. To complement my process of identifying unique ideas (concepts) in the data that could help to answer my research questions, I developed a natural language processing (NLP) tool to be my 'second set of eyes.' This tool consisted of a hybrid summary-generation model: an extractive summarization with sentence transformers (breaking text into manageable chunks and generating embeddings) and a pre-trained abstractive summarization model (e.g., BART) from the *Hugging Face Model Hub* (huggingface.co/models) which enabled prompting with research questions and generating outputs. The outputs of this process were transcript summaries identifying how each participant talked about each topic from my prompt (e.g., motivations to partner with universities, partnership strategies, and each dimension of collaboration from IOC theory). I developed these document-summarization pipelines using *Python* tools (e.g., PyTorch). Although I did not use any of these generative outputs directly in my analyses or results, they were influential to my thinking about and working with each participant transcript during the coding process. For example, where the outputs identified a research question-relevant idea that I had not already captured in my codes, I would revisit the data to explore whether I felt adjustments or additions to my code labels were needed. More plainly, these custom-designed tools identified ideas (concepts) that I was overlooking, pushing me back into the data, challenging my thinking, and supporting the development of higher quality abstractions (concepts, codes, and themes). Working with large language models (LLMs) and NLP tools has become more prevalent in qualitative research (Hayes, 2025). In chapter five,

the potential implications for how I integrated these tools with reflexive thematic analysis techniques are discussed. My analysis proceeded manually (without any LLM/NLP interventions) in the next RTA phases of clustering codes and developing themes.

3.3.3 Developing Themes

A core assumption of RTA is that themes represent patterns of shared meaning (as interpreted by the researcher) and are actively produced through systematic engagement with data (Braun & Clarke, 2013, 2021, 2022). Themes are an output of the analytic process and built from codes, not defined ahead of analysis or self-evident in the codes or data. Whereas codes capture a single facet of an idea or concept, themes are multi-faceted and anchored on a central organizing concept (i.e., the essence of a theme, what it is about and how codes fit together) (Braun & Clarke, 2022). Best practices for developing themes include deciding theme names that capture the essence or central concept, ensuring clear boundaries between themes, the purpose or focus of each theme is clear (i.e., not reporting diverse meaning unless contradiction is the focus of a theme), themes work together to tell an overall story about the dataset in relation to the central research question, themes do not summarize or reduce data but interpret them and explain significance based on the research questions, and theme descriptions work together to tell a rich, interpretive story with embedded extracts of data (Braun & Clarke, 2022). In the initial phase of generating candidate themes, the themes are recognized as provisional and tentative. My initial process of developing themes involved considering all codes (reading them) and exploring broad ideas that multiple codes could be clustered around with respect to the *Five Dimensions of Collaboration* (i.e., I was also thinking about how I would categorize the code clusters deductively), then exploring the clustered patterning of codes across the dataset and generating many different provisional themes. This process was not about directly aligning answers to

questions, but capturing meaningful stories as told by the codes and data (i.e., not explicitly answering each unique research question, but interrogating them), where each story (theme) was unique, coherent, and proposed (interpreted) a central idea that meshed the data and codes together.

In the next phase (phase three) of RTA, I reviewed the candidate themes which involved taking each theme back to the coded data where the code labels aligned to each theme were applied, to ensure each theme 'worked' when read in relation to each data item, and that each theme captured a different central idea and nuance about the dataset that could be conveyed in terms of addressing the central research question. This phase involved the most substantial revision, consistent with how Braun and Clarke (2022) describe this process, where some initially generated themes did not work, and I had to start the process over or revisit the coding phase. Much of the attention in this phase was to clarify the central organizing concepts (i.e., tweaking code labels) and revising themes so that clear boundaries were evident between them. By the end of this phase, I had also assigned each code cluster to a theory-driven category (i.e., one of the *Five Dimensions of Collaboration*) that I felt was the best fit. Clusters that I felt did not have strong alignments to the pre-determined categories were either (1) considered in relation to the central research question or (2) re-worked through iteration on code-cluster development. All final code clusters and the theme names I assigned to them were aligned to a unique research question or excluded in the findings.

The next phase (phase four) of RTA involved revising themes using the full dataset (not just the coded data for each theme like the previous phase). The intention in this phase was thorough engagement with the whole dataset to expand focus, challenge the developed themes and their central organizing concepts, and decide when the analysis met the criteria discussed

earlier (e.g., themes work together to tell an overall story about the dataset). Braun and Clarke (2022) provide guidance on what constitutes a 'good' theme, such as the absence of simply summarizing topics (i.e., themes provide an interpretive take on clusters of codes, telling a story about the dataset), capturing shared meaning (i.e., themes are united by ideas salient across multiple data items), and avoidance of 'question and answer' orientations (i.e., themes do not directly answer questions, they form together to tell a story about the dataset in a way that addresses the central research question). The next phase (phase five) of RTA was refining, defining, and naming themes, which also blended into the final phase (phase six) of writing the analytic narrative (chapter four and five). Phase five was deciding the structure and flow of the analysis, writing theme definitions (like abstracts), naming themes (concise, informative, and recognizable to target audiences), and organizing the data extracts to tell my interpretative story about the dataset. Grounding thematic abstractions in data excerpts also supports communicative validity (Walther et al., 2013). As discussed in chapter four, I departed from Braun and Clarke's (2022) suggested approach in these phases for some of my study results (e.g., I developed topic summaries for certain responses to my research questions, rather than thematic abstractions for all my responses, and chose to headline results with concept-names rather than theme-names).

The final phase of RTA was writing the analysis (results and discussion sections), which Braun and Clarke (2022) offer a wealth of advice and suggestions for including common qualitative techniques such as thick description, balancing data extracts with theme descriptions, contextualizing the data extracts, drawing conclusions and relating them to the data, analysis, theory, literature, methods, etc., and critical reflection on strengths and limitations. Before writing the discussion section, I leveraged peer debriefing by meeting with my dissertation committee to discuss the findings and receive critique on my interpretations. Peer debriefing is a

technique recognized to support communicative validity and process reliability (Walther et al., 2013). Braun and Clarke (2013, 2022) also make a case for how research quality considerations may be addressed throughout the analysis. In the interest of transferability of findings, my analytic narrative also examines the extent to which my findings could be re-contextualized within the broader literature on CSPs and assesses the degree of congruence between what I report and how readers might assume relevance to their unique situations, supporting pragmatic validity (Walther et al., 2013), discussed further in chapter five. I revisited Braun and Clarke's (2022) guidance throughout these phases of analysis alongside Hatch's (2002) and Creswell and Creswell's (2017) guidance on writing the results and discussion sections, and Walther and colleagues (2013) considerations for overall research quality.

3.4 Discussion on Research Quality

In the qualitative research community, there tends to be a lack of consensus on the ways researchers should establish research quality (Walther et al., 2013). Studies often point to standards and wholesale quality frameworks without close consideration of the intended audience and what they may care about most to assess research quality (Walther et al., 2013). Braun and Clarke (2022) suggest that there is nothing inherently wrong with applying 'universal' quality strategies but that it should be done reflexively and aligned with the studies' theoretical assumptions. My interest was not to blindly adopt wholesale quality frameworks or to cherry-pick from them at preference, but to engage in thoughtful discussions throughout the study on relevant quality issues and appropriate techniques that might enhance the overall quality. In this interest, my approach to research quality was to focus on the issues that may be most relevant to the intended primary audience (engineering education community members that are stakeholders of CSPs) and discuss techniques recommended by well-regarded scholars (that may be most

recognizable to the intended audiences) that attend to those issues. I leaned on the insights from Kvale and Brinkmann (2009) for demonstrating good 'craftsmanship', what Maxwell (2008) refers to as 'coherence', and what Braun and Clarke (2022) refer to as 'particularity' as holistic measures of quality in my study. Quality-specific discussions are included in this section but also throughout the report and particularly in the data collection and analysis sections. For discussions on research quality, I often leaned on insights and recommendations from Joachim Walther and colleagues (2013) who attempt to bridge the dialogue on research quality within the engineering education community (e.g., some research scholars prefer traditional measures such as validity while others prefer alternatives such as credibility). I also looked at Andrew Shenton's (2004) work on establishing trustworthiness in qualitative research that builds on work by pioneering scholars Egon Guba and Yvonna Lincoln (1994), Sara Tracy (2010) and her popular 'Big-Tent' criteria, and the well-recognized research design guidance from John Creswell and David Creswell (2017). I focused on three central, interrelated issues of quality that were particularly important for my study: (1) confidence in methods, (2) transferability of findings, and (3) the influence of the researcher.

Confidence in Methods. The interest of scientific research is often to generalize findings to broader populations in ways that are reliable and (objectively) valid, but related conversations in qualitative research tend to be more complex (Braun & Clarke, 2022). There are tensions in acceptable terminology for qualitative research quality (Walther et al., 2013) and researchers often lean on alternatives to generalizability and reliability such as transferability and dependability, respectively (Shenton, 2004). Other qualitative researchers redefine or reconceptualize traditional terminology in their disciplinary communities that may better attend to an overall judgement of quality, such as Walther and colleagues (2013) who relate quality in

interpretive engineering education research to quality control in engineering practice. In interpretive research, expectations for research quality tend to be less about generalizing findings to a general audience and more about ensuring the findings are trustworthy to a specific audience. An important factor in establishing trustworthiness is ensuring that findings are congruent with the realities assumed by the intended audience (Lincoln & Guba, 1985). The issue is about their confidence in how the phenomena are recorded by the researcher—what Guba (1981) refers to as the 'truth value,' Shenton (2004) and Tracy (2010) refers to as 'credibility,' and what Walther et al. (2013) and Kvale (1994) refer to as 'communicative validity.' Techniques that my study employed to deal with this issue included the use of well-established methods (Shenton, 2004) that demonstrate appropriate fit with research goals (Tracy, 2010), peer debriefing which is a reflexive practice of talking about data and analysis with colleagues to develop deeper insight and receive constructive feedback (Walther et al., 2013; Shenton, 2004; Creswell & Creswell, 2017), and thick description, a practice of deep analytical and theoretical engagement with, and a rich (detailed, context-oriented) reporting of, data and my interpretations (Shenton, 2004; Creswell & Creswell, 2017; Braun & Clarke, 2013). These techniques may support a reader's confidence in how I recorded data and reported findings that are relevant to them. Many scholars also recommend a technique called 'member checking' where participants are asked to validate the researcher's interpretations of their conversations (Walther et al., 2013; Shenton, 2004; Creswell & Creswell, 2017; Tracy, 2010; Guest et al., 2012). However, Braun & Clarke (2022) suggest that this technique may only be useful for experiential orientations to TA where analytic narratives are intended to be more recognizable to participants. There were also practical constraints for employing this technique, such as my study participants' limited availability for follow-on conversations.

Transferability of Findings. Another quality issue that was particularly important for my study was demonstrating that findings were applicable to other situations, and specifically that the intended audience could readily make transferable inferences to their own situations. Given that CSPs in engineering education may demonstrate wide variation in collaboration processes, that variation needed to be captured in the data and situated in the experiences of the participants so that a reader could take away insight that informs their own situations. Guba (1981) refers to this issue (need) in terms of research quality as 'applicability,' Shenton (2004) refers to it as 'transferability,' Tracy (2010) refers to it as 'resonance,' and Walther et al. (2013) refer to it as 'theoretical validation' (overlaps with other types too they mention, too, including 'pragmatic validation' which is more about theoretical compatibility). Techniques that my study employed to deal with this issue included purposive sampling which is a sampling strategy for recruiting participants who can best speak to the phenomena (Creswell & Creswell, 2017; Shenton, 2004), developing an audit trail where the researcher provides transparency in decision-making in the process of transforming data into findings (Walther et al., 2013; Shenton, 2004; Kvale & Brinkmann, 2009; Guest et al., 2012), with audits performed by my dissertation committee chair (an IRB-approved investigator in my study), and thick description as previously discussed. Many scholars also recommend a technique called inter-rater reliability (or inter-coder agreement) where multiple researchers conduct data coding and consensus is sought to inform theme development (Walther et al., 2013; Creswell & Creswell, 2017; Guest et al., 2012; Silverman, 1993). However, Braun & Clarke (2022) suggest that researchers employing RTA should instead acknowledge the situated, partial, and subjective nature of their coding processes and that multiple coders may only be advantageous towards gaining richer and more nuanced insights, not building consensus.

Researcher Influence. The last quality issue that will be explicitly addressed in this section is my own influence on the study and how that may impact the overall quality judgement of a reader. Guba (1981) refers to this issue as 'neutrality,' Shenton (2004) refers to it as 'confirmability,' Tracy (2010) refers to it as 'sincerity,' and what Walther and colleagues (2013) refer to as 'procedural validation' (overlaps evident for this type, too). The broader research community often refers to this issue as introducing bias and certainly from a positivist-leaning perspective in quantitative techniques, it could be a great concern. The need is to understand how the researchers' own biases (experiences, values, and beliefs) influence the design and conclusions of a study (Maxwell, 2008). In Big-Q qualitative research, however, subjectivity is at the heart of practice and treated as a resource (Braun & Clarke, 2022; Creswell & Creswell, 2017). This belief does not mean that I could conduct my interpretations on a whim without due diligence towards reflexive practices that make clear how my own biases may have influenced the study. Techniques that my study employed to deal with this issue included reflexivity which involved critical self-reporting of my beliefs underpinning design decisions (Shenton, 2004; Creswell & Creswell, 2017; Tracy, 2010), employing a constant comparative approach to data analysis which emphasizes analysis as an iterative process of re-reading transcripts, cross-checking codes, and repeated confirmations of potential data patterns (Walther et al., 2013; Braun & Clarke, 2022; Guest et al., 2012), and use of an audit trail as previously discussed. Many scholars also recommend a technique called triangulation where researchers use multiple data sources to validate concepts and theories in the analysis (Walther et al., 2013; Shenton, 2004; Creswell & Creswell, 2017; Tracy, 2010; Guest et al., 2012). However, Braun and Clarke (2022) suggest an appropriate alternative for a Big-Q approach is 'crystallization,' where the goal is not necessarily multiple data sources that point to the same ideas but rather an openness

to a complex and in-depth understanding of phenomena through the data available (Tracy, 2010). The performance of these techniques is making decisions in design that seek to reduce random influences (what some may claim as sources of bias) on the studies' conclusions in what Walther et al. (2013) refers to as 'process reliability'. I acknowledge that some of these influences may have surfaced through the data collection and analysis processes, necessitating an exploration of the potential ethical issues which may impact overall research quality.

3.5 Ethical Considerations

In interpretive research, ethical considerations are intrinsically connected to quality considerations but often treated separately (Lincoln, 1995). My intention of separating the discussion on ethics was to explicitly address quality issues that relate to the ethical issues inherent to data collection in interview research. When IRB approval was sought for my study, I needed to be able to not only explain the research but also what was expected of participants, potential risks of harm to them, and the anticipated benefits to them. Several scholars indicate that an important ethical practice in interview research is clearly explaining the purpose of the study to potential participants, before asking them to sign a consent form (Creswell & Creswell, 2017; Kvale & Brinkmann, 2009; Hatch, 2002). Creswell and Creswell (2017) also propose that an ethical issue rests in the power imbalance inherent in interview research and that the interviewer should avoid disclosure of sensitive information. Although the IRB process I followed supported some mitigation of these risks, it was left to me to ensure that appropriate processes were followed. Braun and Clarke (2022) suggest that informed consent best captures broad interests and not the interpretive process of the researcher. The complexities lead to a situation where I needed to consider my responsibilities to the participants holistically and particularly rather than just following the step-processes prescribed by my IRB process.

My responsibilities to the participants included respecting potential power asymmetries (Creswell & Creswell, 2017; Kvale & Brinkmann, 2009)—for example, when a participant does not hold a position of authority and may feel coerced into signing a consent form. My responsibility was to ensure participants were fully informed of their discretion to participate and withdraw from participation at any time (including after they signed the consent form). In my communications with participants, I made clear before, during, and after the interview that participants were able to withdraw their consent at any time and for any reason, outlining the IRB-approved procedures I would follow in that event. Kvale and Brinkmann (2009) suggest that an interviewer should be cognizant of how the interview may create stress on the interviewee and it was my responsibility to monitor participants' comfort level and adjust dialogue appropriately to reduce stress, even at the expense of the interview as a data element in the study. There were times during interviews with participants in my study that I recognized discomfort in the conversation on certain topics. In some cases, I shifted the conversation to new topics and in others, reassured participants that I was only interested in discussing topics at their level of comfort. In transcription, it is the researcher's responsibility to stay 'local' to the interviewee's oral statements and not mis-represent them (Kvale & Brinkmann, 2009). My role as a researcher was to ensure my own integrity in representing participants, transparency in my interactions with them related to the study, and to consult more experienced research professionals and communities when I was in doubt about appropriate actions and decisions (Kvale & Brinkmann, 2009). Data collection is not the only phase of the research design where ethical issues may arise but also through the procedures of analyzing data where interpretation and handling data can harm or misrepresent participants. Braun and Clarke (2013) suggest that researchers need to be sensitive to what data could be identifying of participants when anonymizing data (e.g., certain

readers might be able to decipher which organizational entity or individual presents with unique characterizations). Although complete anonymity is impossible (Braun & Clarke, 2013), thoughtful techniques were employed in my study to increase confidentiality of participants but not so much that meanings were altered beyond what was originally intended by the participants.

Concern for representing participants can be a significant ethical dilemma in qualitative research (Braun & Clarke, 2022). Through my critical orientation to data analysis, I did not seek to tell a story with which participants might agree but was mindful of the potential of analyses to harm individuals and groups represented in data. My ethical responsibility was to ensure participants understood the purpose of the study, how their data would be managed (including a summary of the analytic approach described in this chapter), and how I would report results that connect their stories to my interpretations. In my communications with participants, I ensured participants were provided with this information, following my IRB-approved procedures, before onboarding them as participants in my study. Creswell and Creswell (2017) offer additional suggestions to mitigate ethical risks in analyzing data, such as reporting multiple perspectives and contradictory findings, and developing composite profiles for study participants to anonymize data that may be identifiable to them. In reporting data, additional mitigations of potential ethical risks include honest reporting (i.e., avoiding falsifying data, findings, etc.), communicating in language appropriate for the intended audience, sharing the final publication with participants, and maintaining data storage for the IRB-directed period and no less than five years (per APA guidelines) (Creswell & Creswell, 2017). Although addressing and reducing risks to study participants, ethical reporting of findings, and proper handling of data are all important techniques that support overall research quality, there were also practical, theoretical, and methodological limitations to consider for my study.

3.6 Study Limitations

With smaller sample sizes (relative to most quantitative studies), qualitative research does not often allow for the generalization of findings to general populations (i.e., my findings may not be applicable to all CSP situations in engineering education). Instead, the findings in my study, along with the methods employed, are described in-depth so that readers can determine how well the findings may be applicable to their own situations. My study does not provide a playbook for conducting CSPs in engineering education but instead provides insights into the antecedents to partnerships and the processes that may enable desired outcomes in similar situations. Just as I believe positivist traditions stretch too far towards objectivity and singular realities when claiming absolute truths in social discourse, there may also be claims that my Big-Q approach stretches too far away from truth claims and limits the applicability of findings to practical interests. I do not hold relativism as the only philosophical way of knowing and understanding reality, but rather it is a more appropriate ontological standpoint from which to conduct narrative inquiry. Along that same vein, I do not hold constructivism as the only way of developing knowledge but again believe it is a more appropriate epistemological standpoint from which to view the nature of knowledge (as co-constructed by participants) in qualitative studies of partnerships. The outright rejection of objectivity, common in the purist versions of my stated paradigmatic orientations (Braun & Clarke, 2013), can also be problematic for any reader interested in actionable, pragmatic insights. Readers could claim that if an intended contribution from my study was to improve the CSP situation, a more pragmatic approach may have been more appropriate than the one I followed. Studies that incorporate mixed methods often lean towards this thinking. On the other hand, readers could claim that pragmatism is often post-positivism in disguise (Denzin, 2010), and from this perspective the orientation I took in this

study (i.e., critical relativism) may not be subject to such a limitation in the eyes of some readers. Regardless, my decisions in sampling and recruiting support an emphasis on the practice of CSPs in engineering education. Although I approached the inquiry with theory in hand, my discussions with participants focused more on their experiences, and their storytelling, which may support how readers take actionable insights away from my findings.

There are issues inherent to field studies that may limit intentions in data collection. Accessing the individuals I sought to interview, convincing them to participate, building a degree of rapport ahead of the interview without face-to-face interaction, and getting them to divulge the types of insights I sought were all challenges (Creswell, 2013). Hatch (2002) suggests that it is common for individuals to be reluctant to share what is on their minds, and novice researchers may be less equipped (skilled) to navigate those situations. My interview strategy addressed this risk through intentional rapport development and multiple instances of discussion on the ground rules of the conversations with participants (e.g., confidentiality and protection of their information). Several scholars discuss the limitations inherent to a power dynamic that exists between an interviewer and interviewee (Creswell, 2013; Hatch, 2002; Kvale & Brinkmann, 2009), where the interview is 'ruled' by the interviewer who creates the agenda and leads the discussion, and with full control over the interpretation of the conversations. Counter-control of the interview can happen, too, with the interviewee withholding certain information that may be relevant to the discussion and of interest to the interviewer (Kvale & Brinkmann, 2009). These issues of power may have limited the generation of data during my interview events. My interview strategy included open-ended questioning, encouraging participants to tell their story without any restrictions (i.e., the interview questions were framed as guides to the conversation

and did not prescribe how the conversations would unfold, encouraging the participants to lead the conversations).

Creswell and Creswell (2017) propose other limitations to field studies such as indirect information that is filtered through individuals (i.e., they tell their story, which may not necessarily align with the stories of others who experienced the same events), the researcher's presence (e.g., experience, identities, relative power) can influence how an interviewee provides their insights in what Maxwell (2008) calls reactivity, and that not all individuals are equally articulate or perceptive (e.g., some interviewees in my study may have been less capable in telling rich, detailed, and nuanced stories of their partnership experiences). It was my job as the interviewer to support the participants during the interview events, demonstrate empathy in the conversation (e.g., maintain an encouraging tone and inquisitive posture in the dialogue, and listening intently with cues so that the interviewee knew that I was listening), while also asking probing questions to develop more detailed accounts of their experiences (ref the interview protocol in Appendix A for examples) when I noticed their first takes on the prompts were less descriptive than I was seeking.

Kvale (1994) proposes a few 'standard objections' to qualitative interviews that should be acknowledged as potentially limiting to interview research, such as inter-subjectivity (i.e., interpretation is local to the researcher, their experiences, and perspectives on topics) and issues of reliability (e.g., leading questions). Kvale (1994) suggests that leading questions may not be used enough in interview research and that they can be helpful for checking the reliability of respondents' answers. Some scholars suggest avoiding leading questions altogether (Maxwell, 2008), with others suggesting that they are a useful tool for an interviewer to identify misinterpretations during an interview (Luker, 2008). To address the risks posed by the argument

against leading questions, my interview strategy did not explicitly employ these question types although I found it appropriate at times to bring them in for clarifications. My intention with any use of leading questions was to enhance my evolving interpretations of what participants divulged, so that they were as closely aligned with their beliefs as possible (i.e., I did not seek to 'lead' them towards certain beliefs). A few additional limitations of my study are related to scoping decisions, such as findings that may only be transferable to specific types of CSPs situations (e.g., may only be applicable to a sub-set of engineering education situations), and informants who only provided a limited representativeness of the external partner population (i.e., my criteria and decisions on sample size may only be marginally-acceptable to certain readers). The sampling criteria I employed addressed some of the former concerns, seeking representativeness across a range of organization and partnership types. However, my final sample only included a limited number of participants who represented private, non-profit organizations—significantly less than other types of organizations. The recruiting strategy I employed addressed some of the latter concerns (e.g., small sample size), demonstrating clear rationale and literature-informed decision-making provided in those discussions to demonstrate why the proposed sample size was appropriate for my research study. My study did not consider the institutional or state contexts of the partnership situations described by my participants, beyond the sampling criteria (e.g., public land-grant universities in the United States), which may limit how a reader is able to relate those situations to their own. Future work could consider these contextual elements of a partnership more explicitly. These are just a few examples of the potential limitations of my study, with attempts to address them noted throughout the related discussions, in pursuit of high-quality research outputs from my study that address the central

research question. In chapter five, I continue this narrative to explore how conclusions drawn from the findings may also present certain limitations.

Chapter 4: Results & Discussion

The research design presented in chapter three provided an overview of my approach to conducting this study and how I structured several design elements around Thomson and Perry's (2006) and Thomson, Perry, and Miller's (2007) *Five Dimensions of Collaboration* from their Inter-Organizational Collaboration (IOC) theory. I also brought in 'antecedents' to partnerships, leaning on Wood and Gray's (1991) model that places antecedents as inputs to collaboration processes, because of emergent opportunity from the dataset and my analysis. What I was most interested in was how participants described their partnership experiences in terms of each collaboration process dimension (RQ2)—governance, administration, organizational autonomy, mutuality, and norms of trust and reciprocity—to develop transcendent findings that build toward an answer to my central research question. What I found, in addition to insights related to these dimensions, were data that also provided insights into the antecedents to partnerships—leading to the addition of a research question (RQ1). I also discovered variation across organization types from these data—ideas that placed emphasis on certain insights over others that varied by organization type (sector). This discovery led to the addition of another research question (RQ3). How I addressed each of these three topics, posed as unique research questions, collectively supported the development of my answer to the central research question: **How do organizations outside of academia describe their experiences partnering with universities on undergraduate engineering?**

This question was being asked because of the need to inform the research and practice of inter-organizational partnerships between undergraduate engineering learning in postsecondary education institutions, and external organizations such as businesses and government organizations on the activities supporting the education and workforce-readiness of

undergraduate engineering students. The first research question concerning antecedents to partnership provides insight into the motivations of external partners for pursuing partnerships with universities (i.e., 'why partner') and offers insight into the strategies employed by these external partners (i.e., 'how to pursue partnerships'), building towards the second research question concerning collaboration processes (i.e., 'how to partner') and the third research question concerning variation across sectors (i.e., the difference in 'why' and 'how' perspectives depending on the organization type).

4.1 Research Question 1: Antecedents to Partnerships

To address the central research question, I posed the following research sub-question, inspired by Wood and Gray's (1991) model for collaboration: **(RQ1) What antecedents to partnerships are cited by external partners?** As a 'what' type of question, I was most interested in describing the nature of the phenomenon, as opposed to a 'how' type of question that seeks to understand the ways in which a phenomenon occurs. Consequentially, I decided to shift away from Braun and Clarke's (2022) guidance on theme development for this part of my analysis and instead present findings in a more 'topic summary' type of format. I seek to answer this question in a way that is digestible for target audiences, which may also be more recognizable to participants (i.e., staying close to participants' narratives without more abstract, thematically driven analysis). My study does not consider 'what partners want' or 'how partners behave' explicitly, as is often the desired output of similar studies (Shah & Gillen, 2023). However, the findings in this section may lead audiences to develop these types of insights through their own situations and interpretations.

In the literature review, I discussed how the lifecycle of partnerships often starts with antecedents of partnerships—solving complex problems (Awasthy et al., 2020), interdependent

access to resources (Edmondson et al., 2012) and developing knowledge-building capacities (Gray & Purdy, 2018). Participants in my study speak about these topics both directly and indirectly through their storytelling. I chose to organize the findings in this section into two topics: 1) motivation to partner, and 2) partnership strategies; antecedents to partnerships may be conceptualized as anything that precedes and influences partnerships (Wood & Gray, 1991). For the situation of cross-sector partnerships (CSPs) in engineering education, these precedents and influences show up as motivations and strategies through my interpretation of the dataset. I shift the language from antecedents 'of' partnerships, as described in the literature review and consistent with common phrasing in academic contexts, to antecedents 'to' partnerships in my findings to emphasize the linearity proposed by Wood and Gray's (1991) collaboration model.

4.1.1 Motivation to Partner

To contextualize how participants described their partnership experiences in terms of the *Five Dimensions of Collaboration*, my study sought to explore antecedents to partnerships such as external partners' motivations for pursuing and participating in partnerships (i.e., 'why partner'). My findings are specific to the narratives of my participants and the central research question and do not provide insight into a higher level of phenomenon such as 'why organizations should partner with universities.' Instead, I focus on how participants in my study describe their motivation to form partnerships in the storytelling of their experiences. To present findings from my data analysis related to motivations, I grouped data into three topics as shown in Table 2.

Table 2. Topics Within 'Motivation to Partner'

	Topic	Sub-Topic
Motivation to Partner	Organizational Motivations to Pursue Partnerships	Talent Pipeline
		Branding
		Business Value
		Students' Different Viewpoints
	Individual Motivations Can Influence Organizational Partnerships	Internal Enthusiasm
		Personal Passion
	Champion Perspectives on 'What's Best for Students'	Curriculum Change
		Experiential Learning

The topics and sub-topics shown in Table 2 do not reflect any strategic presentation of findings other than my own decisions on how data should be presented in a systematic and digestible manner for a reader. This decision is consistent with a topic-summary approach to the presentation of study findings (Braun & Clarke, 2022).

Organizational Motivations to Pursue Partnerships. In the literature review, I presented 'benefits of partnerships' through a categorization of benefits to students, benefits to universities and their internal staff, and benefits to external partners of universities. Why organizations choose to partner with universities is closely related to these assumed benefits. For example, access to students is commonly cited in related literature as a benefit to external partners (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Morell, 2014; Schaefer, 2022; Thune, 2010; Vuoriainen et al., 2024), as external partners often seek to identify and recruit talented students into their organizations.

Talent Pipeline. Participants in my study indicated that a benefit gained through partnerships with universities on engineering education is developing a talent pipeline,

influencing their motivation to pursue partnerships. For example, participants noted the following:

> "From a student perspective… we're giving them real world hands-on experience and application of what they're learning in school. In parallel, they're getting to know the company. So, I mean, you're naturally recruiting them. It's like a 'try before you buy' kind of model." – Denver
>
> "We recruited very heavily out of (the student competition team). That was kind of our first go-to place to hire people out of the program… usually we would see the students for several years." – Doug

The specific phrasing of 'try before you buy' that Denver used is employed in the literature as well (e.g., Rampersad, 2015), where external partners benefit from developing relationships with students over time to make decisions on whether they would be a good fit for recruitment and before making a more substantial investment (i.e., before 'buying', or recruiting them into a position in the company). Another participant suggested that developing these relationships can be a long-term approach:

> "We're not going to hire most of the people that we put in and supported in the capstone project. At least at first. But what we did was we put them on a path to be interested in this industry, to go out and work in industry, and now we're actually seeing those folks start to come back and work at (employer) because they remember, like, 'I did a really cool project with these guys. I've now, you know, been working in industry for three or four years and I think I want to go back there.' So, we're sort of playing long ball with that." – Kyler

Along this line of thinking, access to students for the purpose of recruiting may also encompass influencing students' career choices. To the point that Doug made in a quote discussed earlier, this influence may happen over a long period of time. Doug and another participant suggested that reaching students early on in their academic careers is desirable:

> "We had a strategy where we were hiring (students from competition teams) … Once (students) enter the department, their sophomore year through their senior year, they're developing that kind of skill set (we want). And I think capstone is a big part of it, for sure, but a lot of students get involved in project kind of work early. Especially if you want to work on the big projects like (student competition teams). To get on those teams as a senior, you got to be involved with them earlier because it's just in such high demand and there's only so many spots." – Doug

> "We've missed the mark a couple times on, you know, the interns or the senior project folks, you know, show up and they kind of already have a job with somebody else. So, you have to be earlier in the process… Between the (first) and sophomore year, where a lot of students go back home and lifeguard and cut lawns or do whatever work, construction, and I feel like that's the most fertile ground for us to find talent… (We) spend a little bit more time getting them, you know, to contribute that first year, but then they'll come back the second year and we'll have them, you know, a good eye on them and good way to connect with them and hire them. So, I feel like that's a gap for us to exploit in the system." – Ramon

Although I present these data as motivations to pursue partnerships (i.e., to access students), a parallel insight here is the strategy each of these participants employs to reach those students. In the following section I provide insight into strategies at a higher level (i.e., related to partnerships

generally and with less consideration towards lower-level goals and motivators), and so these additional insights may be helpful to certain readers interested in how participants in my study strategize around the topics presented in this section.

Branding. Brand development is another organizational motivator cited by participants in my study to pursue partnerships, which also follows the line of thinking about influencing students' career choices.

> "We've been engaging in senior project work and having interns for the summer… So, we're finding our way. I'm a big believer in the university relations. Building a brand on campus and building relationships with faculty and student leadership and having internships lead to entry-level positions. I think that is one of the best ways to build a workforce." – Ramon

In this part of our conversation, Ramon described the connection between brand development and workforce development. Another participant provided 'strategic' insight into how organizations can accomplish branding through relationships with faculty:

> "The people we want to lead our research at these different schoolhouses are the ones that are going to attract a lot of students and generate a lot of interest through, by advertising for us, because you know, we can only advertise on the days we're there, you know, in person. But we need folks there that are gonna talk about our projects and solicit students… That's gonna cause student interest to grow." – Sonny

Brand development tends to be about more than promoting a company to students. Often, it is about presence and awareness (i.e., a marketing approach), advertising not only career opportunities to students or partnership opportunities to faculty but also the products and services of the company. For example, one participant in my study described their employers' interest in

leveraging university partnerships to advertise software products that they sell. This idea led to the thinking about branding creating business value.

Business Value. When I present research question two results in the next chapter section, I talk about business value in a slightly different way than what I present here, where recognizing the types of value an external partner seeks in a partnership is important for establishing governance. This discussion and presentation of findings are also about business value but with emphasis on why participants pursue partnerships with universities in the first place. There are overlaps between ideas, and I encourage readers to jump ahead to that section to consider the different ways 'business value' shows up as a recurrent theme in my study, also discussed more in chapter five. How participants in my study talked about motivations to pursue partnerships in terms of gaining business value was varied. In one example:

> "In a perfect world, everything has a meaningful connection to the business that has future value. You know, we can do a project that was just good for the students and fun for the mentor, but you know, we really wanted to have a quantifiable benefit you can point to and say 'yeah, that's why we did this project,' because here it is two years later and, you know, the outcome of it is in use, or it's apparent, or it led to something else. So, no projects just for the sake of doing a project for funsies." – Josiah

What Josiah pointed out also provides insights into strategy, where outputs of any investment activity should provide a 'quantifiable benefit' to his employer. Another participant noted a shift in their employers' approach to student projects towards quantifiable benefits:

> "It was a shift in the (internal organization) that kind of owns this (capstone) portfolio, of their priority shifting away from recruiting to being more of, it's the same organization

that does our internal research and development projects, so they're almost viewing these in that same way, like, this is a research and development project." – Mila

Mila represented a government organization in her participation in my study, where we might expect to see less of the 'business value' type of thinking. However, her suggestion that student project activity is viewed similarly to research project activity aligned with the 'business value' type of thinking. I looked more closely at the variations between different organization types in terms of 'business value' and presented those results in the last section of this chapter (research question three). The variations are not neatly divided, and there are overlaps in how different organizations approach partnerships on engineering education. For example, another participant (a 'private, for-profit' perspective) talked about a different type of business value:

"We're not expecting (students) to come to any like specific type of outcome. My favorite mental model is like an inverse consulting project. So, in a normal consulting project, I give you a problem and I only care about the result. I don't care at all how you get to the result. Our inverse consulting project idea is we don't care about the result. All we care about is how you got there and (then) explain to us, like, all the rabbit holes and your processes, and anything that you attempted and tried, and all that information for us is what we're going to use to sort of evaluate whether or not you think the approach was good or bad, and how we can use it. So, it's very meta. We're using them as learning experiments, I think, is a good way of thinking about it." – Haven

What Haven talked about in this part of our discussion was an emphasis on the process over the results in student project outcomes. He recognized that student project output may be less valuable than the knowledge generated throughout the process of doing a project (e.g., Haven describes this process as 'learning experiments'). A different perspective on student project

outcomes was provided by another participant and more focused on holistically impacting government interests:

> "The leadership of (employer) is comfortable with it (student projects) because we know we're getting value, of course. So, there's a great turn on investment because even what we send to them is, you know, not a significant portion of (our) budget, of course, but it keeps them gainfully, you know, interested in providing services back to (employer) as far as like faculty (relationships), mentorship, and leadership of students on projects that are of DoD (department of defense) relevance." – Sonny

To Sonny's point about partnership outputs being of 'DoD relevance,' another participant talked about business value in more holistic terms:

> "We'll make targeted investments to improve that in a way where it not only improves that one company, but it establishes standards, protocols, workflows for the entire industrial base at that tier supplier. So that we raise all boats." – Kevin

These participant perspectives provided a few different ways that 'business value' may be conceptualized, but the takeaway is generally the same: Partnership activity should provide some type of return on the investment made by the external partners, whether that be through talent acquisition as discussed earlier, tangible and measurable outputs, process insights, or broader impacts to 'the entire industrial base' as Kevin describes. There is another benefit that I considered in this grouping of ideas under business value, although I chose to separate it out—how participants perceive students' intellectual value as a benefit through partnerships in engineering education.

Students' Different Viewpoints. Recall from the literature review that several existing studies indicate that external partners may benefit from exploring ideas and 'back-burner'

projects through partnership activities in engineering education (Conradie et al., 2016; Morell, 2014; Vuoriainen et al., 2024; Kunttu, 2017; Goldberg et al., 2014). My finding follows a similar line of thinking where participants indicated that students offer new or different viewpoints (i.e., compared to what external partners have already considered) on the problems that external partners address in their work. One participant described this idea of students bringing different viewpoints as a motivation to partner:

> "We always think that the universities, you know, drive that open-minded thing and kind of exploration. So, we get better results than we do just when we've been, hate to say we've been tainted in industry for working here too long, but the universities really bring a new thought process… It's really good for us, for my team, to hear new thought processes (from students)." – Dustin

Dustin pointed out a different type of value that student project activity brought to his organization—their new ideas and different ways of thinking (i.e., viewpoints) about problems. This suggests there may be a cognitive bias of those working within an environment and when introduced to new problems, it may be more challenging to bring in a new type of thinking to solve problems. My thinking, based on these data, follows that students' perspectives may help to reduce that bias. Dustin and another participant helped to make this point clear:

> "The students bring insightfulness and knowledge base that we forget. You know, it's kind of like at Christmas. You forget what it's like to be a kid and go and run downstairs, open up packages, and I think university students bring that enthusiasm and that insight and kind of thrill back to projects, where sometimes in business, we get bogged down into the day-to-day grind." – Dustin

> "It's that we're engaging (the students) that we're bringing in as interns. I hear the same thing every summer from the leaders, 'I learned so much from my student, they brought in such cool ideas, they showed me new things and new technology I never even thought of before.' So, it's happening both ways. Like the students are bringing in their fresh ideas. They're asking questions that somebody who may be ingrained in the industry couldn't quite grasp ahead. They're that freshness. So, they're like, 'well, why are we doing it this way,' and instead of saying like 'it's how we've always done,' our leaders are now being like 'well, tell me how else we should do this'… The students are really empowering our leaders to ask new and fresh questions." – Violet

Each of these participants made comparable points related to students bringing 'fresh perspective' or 'new ideas' (i.e., different viewpoints) to the work performed by the external partner and to their benefit. I chose to present these findings under the organizational motivations category, although there are several overlaps with motivations at the individual level as well.

Individual Motivations Can Influence Organizational Partnerships. Working with students, influencing their learning and professional development, and being a part of the academic community is a lot of fun. That is my personal statement, and it was discussed in chapter three. Through this research I discovered that I may not be alone in that thinking. I also discovered that these individual motivations could influence organizational partnerships—individual motivations can lead to an increase in partnership activity. All participants in my study expressed positive personal sentiments related to university partnerships. Participants also described others' passions and enthusiasm within their organizations aligned with student-learning focused activity at universities.

Internal Enthusiasm. The idea that personal satisfaction may be an antecedent to partnership was not raised in my literature review because of the lack of supporting evidence or anecdotes in related studies. However, the concept of corporate social responsibility (CSR) did come up in the benefits section and shares similar characteristics (Ankrah & Al-Tabbaa, 2015; Gray & Purdy, 2018; Smith et al., 2018), although as I noted in the review there is little consensus around how this shows up in partnerships. Participants in my study helped to provide more information towards our collective understanding of how individual enthusiasm (i.e., personal satisfaction) may influence organizational motivations to pursue partnerships in engineering education:

> "Everybody kind of just did it for fun at that point. But we all would have regular interaction with the team campus visits." – Doug
>
> "The engineers love interacting with the students and passing on what they know and helping the students. So, make sure they have the opportunity to do that because that's going to benefit the students then the people who are working the projects." – Kyler

Whereas Doug reiterated my suspicion that 'fun' does play a role in individual motivations, Kyler also brought in the idea that there may also be a quantifiable benefit. One prior study noted that providing working engineers with project management experience (via student projects at universities) supports their own professional development (Morell, 2014). Although there are some distinctions between these ideas, the common thread is that personal satisfaction may play a role in individual motivation. Participants in my study described how individual motivation may also be a part of their university engagement strategies:

> "So, maybe I would want to kind of have them (alumni) come back and share their story and their narrative. Leaning into those networks I think is really smart for a lot of professors and for a lot of career centers." – Violet

> "My first advice I would give (universities) is to connect with alumni currently at our organization… because those are going to be the people who are going to help you make relationships and who are actually going to care." – Mila

These strategies are about the individual motivations of alumni of universities who participate in partnership activities, potentially leading to increases in partnership activities. Mila continued:

> "I think people have, you know, a sense of school spirit and like to stay connected." – Mila

Leveraging alumni networks as part of a broader university partnership strategy is an important topic that I discuss in a subsequent section. The point here is that individual motivation does play a role in antecedents to partnerships in engineering education, according to my interpretation of participants' experiences, and can influence organizational motivations to pursue partnerships. Participants in my study also talked about their own personal passions and enthusiasm related to university activity.

Personal Passion. When discussing the 'third space' of partnerships in the literature review, the idea that personal passion or motivation as an antecedent to partnership did not come up. However, a thread of ideas inspired by existing studies could be strung together to provide literary support. For example, Veles and colleagues (2020) note that the most vital role of a champion is to build and sustain relationships, developing relationships is often cited as more important than tangible outcomes of partnership activity (Keast et al., 2007; Thune, 2010), and

personal interests are key to developing strong relationships (Sjöö & Hellström, 2019). Participants in my study helped articulate this idea in more concrete terms:

> "It's engaging. I love (working with universities). It's always a good time, you know, going back on campus and engaging with students." – Micah
>
> "It's nice to get back to campus and get to talk to students and I really enjoy the recruiting part of my job and, you know, trying to bring people on. So, getting to be that point person. And getting to do a bit of mentorship. That's something I also enjoy." – Mila
>
> "Part of it is, in my case, you know, a genuine motivation to help students find out what they want to do… I just want to give that same opportunity to other people, and for the (students)." – Kyler
>
> "I'm also very much invested in the student experience and wanting to make sure that the students get what they need out of the project, both academically, personally, and professionally as well. So, it's kind of a combination of the two, and one of the reasons I love my job so much." – Carla
>
> "I really believed in the mission (of my employer), and that is we're really wanting to drive the skills and abilities and making students better in the industry that they're going to." – Aarav
>
> "That's kind of where the passion is partly for me and it keeps me doing (this work)." – Caleb

Although I would not suggest that 'data speak for themselves,' this is one situation where I do propose there is a strong idea coming through directly from these participants' narratives—personal passion for supporting student learning and development is a clear individual motivator

to participate in these types of partnerships. Other participants brought back the idea of individual motivations from the perspective of being alumni of partner schools:

> "Having been a (graduate of the university). And really, you know, caring about what goes on down there. I think that kind of takes care of the trust part." – Byron
>
> "I view it (advisory board participation) as an opportunity to serve the institution that, you know, gave so much to me in my education… I do enjoy the interaction." – Ramon

These findings indicate that participants in my study and others within their organization-internal networks recognize personal, individual-level benefits in participating in partnerships with universities on engineering education. Participants in my study also described their personal perspectives on what and how engineering students are taught within academic settings.

Champion Perspectives on 'What's Best for Students.' The primary beneficiaries of partnerships in engineering education are students (Morell, 2014; Rampersad, 2015; Thune, 2010). There are tensions in the thinking about the types of value and benefits offered to universities and external partners through these partnership situations. However, a more common consensus is that students directly benefit from partnerships that involve practical, authentic learning experiences (Ankrah & Al-Tabbaa, 2015; Burns et al., 2018; Kunttu, 2017; Lamancusa et al., 2008; Lucietto & Peters, 2025; Safrit, 2014). Participants in my study who are champions of CSPs offered their perspectives on what and how students should be taught within academic settings. This may be a 'touchy subject' for many academics and others who recognize tertiary education systems and providers as better equipped to make claims about what and how students should be taught in their settings relative to others outside of academia. This topic is less about discussing antecedents to partnerships and more about presenting data relevant to antecedents to partnerships that were generated through the interview discussions.

As I explained in chapter three when discussing my role (and influence) in this study, it was not my interest nor intention as a researcher to tell participants' stories in this section as informed by my own thinking about what students should learn or how they should learn it. There are ideas presented here that I both agree with and disagree with. My task and intention was to tell the story of the dataset, through my interpretation and systematic scaffolding of ideas, while doing my best to stay as close as possible to how the participants described their ideas and experiences. This approach is also important for the reader who may be tracing narratives throughout these results to develop their own insights from certain participant perspectives on curriculum and pedagogical practices related to external partnerships. Recall from the literature review that there are often competing interests and ideas around desired outcomes for students through partnerships (Gillen et al., 2021). My findings in this discussion provide additional insight into how external partners perceive curriculum and student learning through partnerships.

Curriculum Change. Advancing curriculum through external partnerships in engineering education is commonly cited in related studies as a benefit to universities, internal staff, and students (Ankrah & Al-Tabbaa, 2015; Lucietto & Peters, 2025; Safrit, 2014; Vuoriainen et al., 2024). The participant perspectives I provide in this section are not intended to indicate any consensus, or distinct variations, but rather provide diverse, data-informed insight into the topic of curriculum change. Often, participants talked about what they would like to see versus what they presently perceive is happening within the academic setting. For example, one participant talked about the timing of when certain discipline topics are taught within an engineering degree program:

> "The first year of the (students') program is really teaching general knowledge. So, the student came in (to internship) and I said, 'I need you to study, you know, (specific

topic),' and they're like 'what's that,' and I said 'well, it's what you're learning in (school),' and they say, 'we don't learn that until the fourth semester,' and I'm like, 'but that's your whole degree.'" – Dustin

From Dustin's perspective, there may be opportunities to bring in discipline-specific subject matter earlier in a typical degree program. Another participant talked about timing of learning activities in engineering degree programs:

> "One other thing I want to touch on. I think that what I've seen, working with schools… like the core ME (mechanical engineering) or core systems engineering (programs) is they front load a lot of the (experiential) work and a lot of that kind of design thinking, and then they backload it. And there's a huge portion in the middle where they're doing thermodynamics and fluid power and statics… For some reason (schools) go like, 'let's get them hooked, let's get them excited, let's bore the hell out of them for two years and then let's get them excited again.'" – Aarav

The point that Aarav may have been making is that there is an opportunity to improve when certain learning activities take place within a typical engineering curriculum. Specific to capstone-like learning experiences, another participant offered their perspective:

> "So, the capstones that are senior year, the senior design projects, you know. I'd rather see them do that as sophomores or juniors, because also, you know, seniors (are thinking) 'man, all I got left in Spring is my senior design project… I'm just there to check that box.'" – Alex

Alex described what he sees as an opportunity for bringing authentic project work, like many capstone projects offer for student learning, down into earlier stages of curriculum. He continued:

> "So, my opinion, you know, we need to be doing (projects) at the (first-year) level. Teach them these skills here, then they get to use them throughout their tenure at the school. And then when they go and use them on the (competition) teams and all that kind of stuff, you know, that's where you have the multi-year ability for a student to participate in something. And the capstones, just, that's an old model." – Alex

The point here may be, through my interpretation of Alex's ideas, that the scaffolding of learning in an engineering degree program, where it can often be senior year before students can do 'real-world' projects, could benefit from adjustment where younger students (as young as freshmen year, according to Alex) develop skillsets that support learning in later years. Alex also offered his thoughts on assessment practices in engineering education:

> "I think the big disconnect is, you know, the learning they're actually getting when you're doing learning to get a grade in some cases… (and) that becomes just a rote copying of something from some class… The real thing they learned is something they don't get graded on… It's great if you have a degree, knowledge, and background in certain space. But when you're out there in industry, you start to do other things to be able to realize some of these technology outcomes, and those other things are really things that are wrapped up in collaboration, teamwork, communication, time management, you know, understanding the scope of a project." – Alex

Presenting these data in this section was intended to provide insight into how participants in my study talked about engineering curriculum and what they feel is 'best for students.' Several other participants offered their ideas about specific types of learning activities that provide students with real-world experience.

Experiential Learning. Experiential learning, often described as learning by doing, has been a common component of engineering education for many decades (Trembrevilla et al., 2024). Undergraduate engineering programs typically incorporate experiential learning into curriculum through project- and problem-based learning like labs, workshops, and individual and team projects (e.g., capstone). Participants in my study offered their perspectives on how experiential learning shows up through partnership activities:

> "From a student perspective… we're giving them real-world hands-on experience and application of what they're learning in school." – Denver
>
> "Making them (students) aware of the application space for what they're learning and how they can contribute to a lot of these topics and then ideally the student will go out there, conduct this research… (and) apply what they've learned." – Sonny

These participants made the point that the application of engineering learning can happen through the project activity they are a part of, which can also lead to other outcomes such as jobs:

> "I would say within that goal is also obviously the opportunity for students to get experience in the field, to be able to have experiences that then lead to jobs." – Carla

Other participants talked specifically about experiential learning topics through capstone design experiences:

> "The interesting idea of capstones… students are getting learning leverage. So, you're going from taking tests and writing papers or doing labs to actually working with people doing actual problem-solving, which gives you experience that you can't get without doing it firsthand." – Haven

> "(Capstones) actually teach them the very fundamentals of the design and acquisition process. So, first you have to get yourself a design and then once you see if that design closes, then that tells you what you have to go buy. And then once you buy your stuff, you know, before you start putting it together, you have a review and a PDR (preliminary design review) and CDR (critical design review), and they teach that whole process at least in the top level to the students. And I think that really does a good job of preparing them for, you know, their first job when they come out." – Kyler

These participants suggested that capstone design experiences provide students with a special type of learning (what I refer to as experiential learning in this section) that may be less accessible in traditional coursework. Kyler continued:

> "So many early career students just don't know what it's like to work in a team environment and again in the framework of, here I'm working towards a closed design, here I'm working towards hardware I can build, here I'm working towards delivery. Just giving them that context just really, I think, it's very valuable." – Kyler

What Kyler may have been suggesting is that capstones tend to provide students with more contextual knowledge around the learning activity, which may be more reflective of real-world engineering practice. Another participant talked about other unique benefits of the capstone experience:

> "Getting the students to trust us that we're very serious when we say it's okay to make mistakes and fail, and to talk about it and explain to us what you were thinking and what led to it… It's a very interesting psychological space… You've been in this teaching school model where the test is gauging what you allegedly know. But in the real world, the tests don't operate like that. If you keep trying to improve and fix things, you can

> eventually solve a problem… I don't feel school does a very good job teaching people how to solve problems. I think that the capstone experience is, in my opinion, one of the better models to cultivate this problem-solving, like, more realistic experience around learning in the university setting. So, getting that trust that it's okay to fail, and it's okay to not know what to do and to communicate it. Because that's the other thing, like, everyone makes mistakes. But is there a trust that you can say to the person that you're working with, 'hey, I'm trying to do this, and I don't know how to do it. I don't understand why it's not working, and this is what I've tried to do.'" – Haven

What Haven pointed out was that, through these 'real-world' projects, failure may be defined in a separate way than traditional coursework learning. Along with this same line of thinking, another participant offered their thoughts on real-world problem solving in engineering:

> "So many students fall into that trap (saying 'I don't do this') … I want you to go justify what you're doing here. These are the things you go to, and this is gonna inform what you're going to select, because there is no right answer. Students say 'well, there's got to be a right answer.' No, there's not a right answer. There's your answer, and we want you to defend it, you know, and getting students to think that way." – Alex

Alex suggested, when he was talking about project-based learning during this part of our conversation, that certain learning experiences may place less emphasis on a 'right' answer and more on the process of developing an answer and providing justification for why it is an answer that fits the question or problem. Capstones and similar project-based learning experiences offer students learning that extends beyond a typical classroom, where there are less 'right' answers, 'failure' may only be an opportunity to iterate and improve, and recognizing the context of problems may be as important for learning as the problems themselves. There are other forms of

experiential learning that show up in undergraduate engineering through extra-curricular activities such as student competition teams:

> "All those different aspects of real hardware and real-life situations, real design situations, I just feel like it's a really great initiation into the real world." – Byron
>
> "A lot of those competition teams, they have a two year, you know, sort of event rotation… With their emphasis to start to bring in sophomores, and in some cases are bringing in (first-year students), I mean, that's a good thing, because then they get exposed to all that now. The thing that's not necessarily good about that is that it becomes too technically oriented within the discipline… Teams have students with different skills, and in some cases they have students from different engineering backgrounds, but most of them tend to only be within mechanical or industrial or electrical or something (specific). And so, you lose that connectivity to collaborate across disciplines and be able to communicate with different people and rely on other people's skills." – Alex

The point that Alex may be making is that multi-disciplinarity is likely to be present in the learning experiences related to student competition team activities. Other participants offered thoughts on integrating disciplines through experiential learning:

> "All the other multidisciplinary students that were in this project, the ones that would present at our conference were only the engineering students. But at the end of the day, their project had like twelve students, and they were from all different departments to make this work, like in a regular organization. You know, they had a finance guy who put together the finances of how this is going to work at the end of the day. So, it was

interesting that they ran this like a corporation versus a university project based on just the thought of engineering… I did appreciate that." – Julie

"I believe (university partner) has one of the right mixes going in there, where you have good business students kind of working together. You're going over projects over a longer period of time. I think that's really beneficial. You don't see that out of many universities. That structure… They had the design guys in there with engineering team to really drive some different thought processes." – Dustin

Experiential learning as a field of study in engineering education research includes many other activity types beyond capstones and student competition teams. Participants in my study offered their perspective on a few of these activities and the type of learning that may occur to the benefit of students. Although this section on what's best for students may be less about partner motivations, I included it here because it provided relevant context around how participants think about these student-facing activities. Another important form of context is moving from 'why' organizations and individuals participate in partnerships in engineering education to how they approach these partnerships—making decisions about who to partner with, how and where to get started, and other aspects of forming partnerships.

4.1.2 Partnership Strategies

To answer the research question about how partners describe antecedents to partnerships, this section provides findings that consider how participants describe their strategies for pursuing partnerships in engineering education, building on the ideas presented in the former discussion on their motivations. This part of the answer is less about the 'why' and more about the 'when, where, and how' with respect to forming partnerships (i.e., not directly addressing 'how' with respect to process, which is covered in my answer to research question two). Like the former

discussion, I focused on how participants in my study described their specific strategies to partner in the storytelling of their experiences. To present findings from my data analysis related to strategies, I grouped data into three topics as shown in Table 3.

Table 3. Topics Within 'Partnership Strategies'

	Topic	Sub-Topic
Partnership Strategies	Deciding Which Universities to Partner With	Research Commonality
		The 'Proximity Bias' of Choosing Partners
	Where to Begin Forming Partnerships	Leveraging Alumni Networks
		Leveraging Established Structures and Processes
		Employing Low-Risk Strategies
	(Eco)Systems Thinking	Building Multi-Party Ecosystems that Support Workforce Development

Deciding Which Universities to Partner With. Recall from the literature review that the body of research dealing with external partnerships in engineering investigates the research-partnership situation more often than the education-partnership situation (Campbell, 2017). Although the focus of my discussions with participants was on the education-partnership situation, several participants described how their research-partnership interests influenced how they partner with universities broadly and included education-focused partnerships.

Research Commonality. The approach of several organizations that participants in my study represented provides insight into how research and development (R&D) interests drive decision-making for which universities and engineering programs to partner with. One participant, when describing how his organization does not disentangle 'research' interests from 'workforce development' interests when deciding which higher education institutions to partner with, provided insight into their process:

> "We do a bunch of research to figure out who is the best at that thing… Who publishes on that topic, or has published, you know, who's got patents on that and in that case you

need to know not just who's the inventor but who's the assignee. And that assignee might not be the school… So, you do the research to figure out who's got the top capability, and if it's not one that we already have a currently relationship with, then we go knocking on the door." – Josiah

Josiah is also a participant who indicated that everything his organization does through partnerships with universities should have a "meaningful connection to the business that has future value," as presented earlier. This statement provides context for how he thinks about the decision-making around forming partnerships. Josiah continued:

"Our university philosophy is, figure out what our priorities are and find the best partner. And you have to periodically revisit that. Well, what are our priorities now. And who are the best in those areas." – Josiah

Another participant described a similar process and how they look to organization-internal experts to support the identification of potential partner institutions:

"I establish it (university partnerships) by mutual interest in areas. So, I mean, it may be really orthogonal to what you've seen before, but this comes back to, in my mind, some of the most successful things… So, I've got a lot of really smart SME's (subject matter experts). They're out in the community. Their mission is to understand what the bleeding edge is, be a participant, do as much as fast as possible… and be the scouts and be the innovators that are driving the future. By default, they find the best partners… Good problems, good people, and the money will flow. If you have a plan. And I believe also with that the good people and the development in the workforce will flow from that." – Kevin

What Kevin may have been suggesting is that workforce development as an organizational priority is secondary to R&D priorities, but he believes that the former priority happens naturally through the opportunities afforded by, and relationships formed through, research-focused partnerships. Another participant offered a similar perspective and brought in the role of executives:

> "That's how we here at (employer) have tried to stand up our strategic university relationship approach… Do we have a senior leader who feels strongly about a connection with the school. Usually, it's a (graduate of the school), but not always. And if we have a combination of a senior leader that cares and wants to develop the relationship, and that school has an expertise to offer (us), you know, from our core technology and other competencies, then we'll go after that." – Ramon

These participants, who represent organizations across sectors, indicated that research commonality may be a primary driver for deciding which universities to pursue partnerships with and that education-focused partnerships are formed through the relationships established by research-focused interests. Another participant provided a more holistic type of perspective on this topic:

> "You're gonna need a relationship with a value story, you know. Here's our student body. Here's how we rate nationally and academically. Here's, we've got specialized fields with what you do, you know… quality of professors. They (university) had the lab facilities. They had an actual operating (specific lab equipment). I mean, they had a number of things that other universities didn't necessarily have, that made them kind of a powerhouse of (specific technology) … So, being able to tell that value story about how their staff and facilities are uniquely tailored to your business." – Micah

Micah suggested that strategic alignments of research areas may be a key factor in making decisions about which universities to partner with, but that they may not be as easily disentangled from their workforce development interests. Each situation should tell a 'value story' about a partner's common strengths towards generating benefits (i.e., value) to each partner. One participant suggested that faculty expertise may drive decision-making for which universities to partner with:

> "It's the (university) is where this relationship lies and the heart of it is with a professor. So, asking what the best in our experience, finding a professor that is interested in the same types of problems that you're looking for is such an enormous leveraging factor in the quality of the whole experience in working with engineering students. Because now, instead of sort of operating in the dark as to what types of problems you're trying to solve, what types of data you have, what types of skill sets the people that it could help out need, this person is already versed in knowing, like, what you've done and what projects you've done in the past, what you liked, what you didn't like. So, then they use their expertise to sort of design the team around specifics of what you're looking for." – Haven

Based on the storytelling of these participants related to their partnership strategies, we might recognize that education-partnerships are not always formed through workforce development interests but also through, and at times driven by, research-partnerships. However, research commonality is not the only factor in how participants described making decisions on how to pursue partnerships. Several participants also suggested that the geographical distance between organizations is a key factor.

The 'Proximity Bias' of Choosing Partners. Although my literature review did not cover the topic of geographical proximity in cross-sector partnerships, there are other studies outside of the engineering partnership situation that provide insight. For example, a study by Rossi and colleagues (2023) found that geographical proximity influences the probability of university-industry collaborations to be formed. Participants in my study discussed how geographical proximity impacts how they decide on which universities to form partnerships with:

> "I would definitely say, like, one big thing is geography. So, I would say this is a benefit in our case, but one of the reasons we're partnering with (university) is they're pretty close. So, I'm in (nearby location). Like, they're just, you know, hopping in the car and drive for a few hours. I think it would be a very different relationship if we were partnering with (a university further away) … I think it makes it easier that they are close geographically." – Mila
>
> "And (university), because we've got all these facilities there. (Another university), because they moved our headquarters to (nearby location). So, you know, what is that, the nearness bias. But yeah, you work with the people who are close to you... We've done lots of projects with them (university) … because that's where (employer) is at, or (another university), because it's right here in (location)." – Josiah
>
> "We're thinking, well, (university) is so far away, is that really beneficial to us. We'd really like something, a university to partner with, within a driving distance." – Dustin

These participants indicated a preference for partnering with universities that are 'within driving distance' to their work locations. Josiah called this a 'nearness bias,' which is like the more common term 'proximity bias.' Another participant talked about proximity in terms of reaching and recruiting students:

> "The other thing I'd say is with the students, you know, potentially want to come work and live at one of our (employer) sites. One of the things we learned at (employer) was that if we recruited at (university) or (another location) or some of these other places (further away). It was hard to get them to want to live in (employer location). That's why (closer universities) became, you know, more fruitful ground to establish relationships that were successful." – Ramon

Along these same lines concerning proximity and students, in terms of skill sets (the types of engineering degree programs offered by the university, presumably), other participants offered perspective:

> "I would say first, choose wisely on the institutions. You want to engage the academic institutions you want to, because you can't do it all. So, find the few that are really well suited to you in regard to the skill set, though be able to crank out the location because if the ultimate goal is to attract (local talent). Awesome, you know, we'll talk about it. So, location matters. Skill set matters." – Micah
>
> "Where do we want to spend our time. What universities, organizations, and colleges make the most sense for our future workforce." – Violet

This discussion and presentation of findings related to partnership strategies sheds light on how participants prioritize certain organizational factors such as geographic location in their decision-making around pursuing partnerships with universities. Entry-point strategies (i.e., where to start forming partnerships and how to start that process) are, however, more varied.

Where To Begin Forming Partnerships. Recall from the literature review that partnerships can be formed along a continuum of approaches, from passive opportunity or personal interest to intentional, strategic organizational initiatives (Morell, 2014). What was not

covered in the review are the specific entry-points to partnerships in engineering education because of limited prior work. There may be some reasonable assumptions such as appointments to advisory boards, formal processes for sponsoring capstone projects in engineering colleges and departments, and existing relationships (e.g., research partnerships) that create opportunities for education-focused partnership activities like guest speaking, workshops, undergraduate level independent studies, and novel project-based learning situations. A few of the strategies suggested by participants in my study are presented in this section and include leveraging alumni networks, reaching out to organizations and individuals within universities who specialize in external partnerships (e.g., Technology Transfer Offices, commonly associated with research partnerships as described in the literature review), and offering advice on low-risk approaches to explore opportunities for higher-risk partnerships.

Leveraging Alumni Networks. It is no secret that alumni relationships are important to higher education institutions (e.g., Safrit, 2014). Based on the storytelling of participants in my study, I also suggest that alumni relations can be a strategic leverage for external partners of universities to establish relationships and form partnerships with universities. As indicated by participants in the previous section on motivations, alumni may be more likely to be personally invested in their alma maters and have existing connections with faculty and staff. Participants in my study discussed this idea:

> "My first advice I would give (universities) is to connect with alumni currently at our organization… because those are going to be the people who are going to help you make relationships and who are actually going to care." – Mila

Mila was more direct in her suggestion that alumni connections can support partnership formation through their personal connections and investment. Other participants offered broader insight into their strategies:

> "If you've got a university that has a relationship with alumni at an industrial company, tapping into that would be first and foremost." – Micah
>
> "And then also, just with the (alumni) working it (projects), you know, working with the university and staying in touch with the university that way." – Byron
>
> "Our partnerships with certain key faculty… you know, professors, that people on our team knew from when they were students and were able to kind of connect with them, and their undergraduate advisor roles, and connect us with students." – Ramon

These participants echoed the suggestion that leveraging alumni networks may be an important strategy for pursuing and forming partnerships with universities. One participant offered a more specific, systematic strategy for how their employer approaches university partnerships:

> "We have an ambassador program that we started here at (employer), and I will send out specific events that align with their location or the university or college they attended. And usually, we get great buy-in and so they'll go and help represent the company… I want to lean into that as much as possible, so I use that network all the time, like, I'm doing a (workshop-type activity) with that group of ambassadors right now." – Violet

What Violet was indicating is that her employer creates dedicated groups of employees ('ambassadors') who are aligned with university partners based on both location (i.e., there is a proximity consideration) and personal connection (e.g., attended the school), to support education partnership activities. Another participant offered a different, specific, and systematic perspective on strategy:

> "We had corporate engagement at the highest level. So, you have (an executive) here, who's appointed (university) executive champion, and then, you know, he kind of reached out and pulled in some others at (employer) for us, and they would, you know, work with the university and team at (university location) to make sure we were on this call and started establishing some relationships. That, to me, felt pretty successful… There was energy from the top and there was a commitment." – Micah

Micah suggested that his employer's strategy for forming partnerships starts at the executive level, where senior leaders form relationships (whether alumni or not) with universities which can proceed to 'trickle-down' relationship development and partnership activity to lower levels of the organization. Other participants indicated that their strategies were more focused on leveraging established structures and processes for forming partnerships such as working with dedicated partnership liaisons within universities.

Leveraging Established Structures and Processes. As discussed in the literature review, there is often a 'third space' of partnerships where intermediaries, both organizational and individual, operate specifically in support of cross-sector partnerships (Eddy, 2010; Edmondson et al., 2012). Organizational intermediaries, such as technology transfer offices (TTOs) and offices of industry relations (OIRs), are usually staffed by specialists who have experience working across academic and non-academic sectors, facilitating partnerships between different organizations (Perkmann & Walsh, 2007). Participants in my study offered their perspectives on locating dedicated partnership intermediaries at universities and navigating established structures and processes for university-external partnerships:

> "I figure out, okay, this is who does what I do at that organization. I follow them (on LinkedIn). I sent them a note and I'm like, 'hey, this is who I am and why I'm reaching

out'… So, find out who the people are that are literally in roles (at universities) that are supposed to facilitate that and get that conversation started." – Caleb

"It was a lot of networking and a lot of cold calling at first, but then (university person) was a fantastic partner to help make those connections and, you know, make the translation of, okay, they're interested in that. This department in (university) does that somewhere. So, that's how I established it." – Kyler

What Caleb indicated was a mix of approaches, both interpersonal networking and discovery of dedicated partnership intermediaries, for how his employer approaches partnerships with universities. What Kyler suggested is that individual intermediaries play a vital role in establishing and building relationships within the universities. Another participant offered a unique perspective on this approach:

"A lot of (faculty) are totally open to collaborating and working… That's a level of engagement and the right level for participation, for folks to have, if it can be recognized by the organizational constructs within the university and the industry partners." – Alex

Alex indicated that faculty relationships can be entry-points to university partnerships, too, and talked about his preference for working with individuals at these lower levels of university hierarchy in support of his employer's goals for university partnerships. He also noted that the 'organizational constructs' of universities and external partners may not always align with this strategy. Other participants commented on better established and more recognizable approaches:

"I do think from a career services side, the best thing that they can do is create those opportunities for students to connect directly with employers. I love networking events where it's less formal information sessions… Anytime we can get people together and

> they can just have an open dialogue, the better, without stressors from like a career fair." – Violet
>
> "I would suggest that they find out what our needs are. What are our gaps? What are our needs?... Then engage us in a dialogue about the art of the possible and how they can support us." – Ramon

These participants approached this topic from a different angle where universities initiate the formation of partnerships. It is important to recognize that forming cross-sector partnerships does not always happen linearly, but also through non-linear exchanges that can originate from either party. Although some partnerships that are formed at higher levels of risk and approach are common in cross-sector partnerships (e.g., sponsoring a capstone project or collaborating on a co-op program), oftentimes there are low-risk approaches that external partners consider for their partnership strategies.

Employing Low-Risk Strategies. In the literature review, I discussed how partnerships often form organically between individuals with prior relationships (Kezar, 2005; Lucietto et al., 2020; Thomas & Lancashire, 2010), and incrementally from small-scale relationships with lower risk to larger-scale partnerships with higher risk (Perkmann & Walsh, 2007; Thune, 2010). Although there are tensions in existing research on whether partnerships should be formed at individual or organizational levels (Kezar, 2005), I chose to include this discussion on employing low-risk strategies because it may have relevance to audiences interested in forming partnerships through incremental and experimental approaches as opposed to 'eating the elephant in one bite,' as one participant stated:

> "Maybe we don't do it all. You know, don't eat the elephant in one bite here. Let's try a section or two (of a course) first… (or) let's do a workshop for them (students). Then deploy this in that course." – Aarav

In this part of our discussion, Aarav was talking about the challenge of deploying a software tool, provided by his company at no cost, in an engineering course. Bringing faculty and teaching assistants up to speed on the tool and how it could be integrated into existing content for the course was the intention, and Aarav indicated how starting at a smaller scale with the goal of larger scale deployment was the strategy. Another participant provided similar comments on low-risk entry-points for partnerships with universities:

> "I would say, you know, pursue low-cost ways first. Send a couple (of) interns for the summer. See if you can get some interns hired on or have a guest lecture or something, like, a free or you know, a couple hundred bucks. Engagement is going to be a lot more palatable than spending, you know, sixty thousand dollars to sponsor (research)." – Mila

Mila was talking about forming partnerships with universities through low-cost and low-risk approaches, including recruiting activities. This approach is common, where career fairs and similar recruiting-focused activities are typical entry-points for external partners of engineering education (Smith et al., 2018). Another participant offered a different type of perspective on this topic of low-risk strategies:

> "Viewing it like a pipeline, you always want to be making new relationships and trying new situations. So, I'll start with one of our best relationships and then I'll work back to like how we think about starting with a new one." – Haven

What Haven may have been suggesting is that building relationships with new organizations and individuals becomes easier over time, learning and improving through repeat performances.

These topics related to partnership strategies are not exhaustive nor meant to cover the full range of approaches that external partners take to form partnerships with universities on engineering education, although participants in my study did have strong insight to offer through their storytelling specific to these topics. As I mentioned earlier, not all strategies are linear or systematic, and from the literature review we can recognize that some cross-sector partnerships are considered at higher, strategic levels involving several organizations (BHEF, 2013; Eddy, 2010; Rios, 2022).

(Eco)Systems Thinking. It may not be common to present a finding in a qualitative interview study as supported by only one participant's narrative. However, I felt strongly enough that what Kevin talked about, related to building ecosystems that support workforce development, warranted this approach. This topic is a slight departure from how I presented narratives on partnership strategies, but the ideas are similar, and I chose to include it here as continuing the discussion around antecedents to partnerships.

Building Multi-Party Ecosystems that Support Workforce Development. In the proceeding discussion, I walk through a single participant's narrative to deeply explore many different ideas around workforce development strategy at a societal and economic level—a departure from the typical format for how I have presented results in previous sections. What Kevin offered was a rich, nuanced perspective on how ecosystems can be formed to support not just one organization's goals, or one institution's goals, but addressing the greater societal challenges for workforce development.

> "At the end of the day, we need to synthesize the community and so we're very bullish on partnerships. And when I say partnerships, that means partnerships of equals to forward the solution by mutually dependent contributions." – Kevin

How Kevin talked about partnerships in this part of our conversation may be quite different than other participants' storytelling from previous discussions (e.g., some participants place emphasis on transactional exchanges where business value is sought through partnerships). What Kevin may have been suggesting is that partnerships are one way to address common, higher-level challenges—beyond recruiting, providing projects, and influencing curriculum, and extending into solving complex problems collaboratively. He continued:

> "To do that, we do a variety of things to generate those ecosystems everywhere from, I'm just going to throw some examples out, so, university centers of excellence, the very lowest TRL (technology readiness level) level where we'll do a five-year effort. Bring one or a few universities together to try to do cross-disciplinary research to generate new skillsets and new workforce so new people that have these convergence of capabilities and experiences that we can't find anywhere else that we need. So, that's for us, kind of like very targeted through research shaping our workforce in the future… I need a team, but I need people trained that I want to hire that have that experience. So, that's one way we do ecosystem building for workforce." – Kevin

What Kevin described is a longer-term strategy of his employer to integrate research and workforce development efforts on a larger scale than that of independent partnership situations. He continued:

> "To emphasize this point, I'll give you an example of what's happening at (university) on some of the external advisory boards... Four or five years ago, (a business) came in and said we're going to build this big (manufacturing facility) outside of (location near university). And (the university) stood up there, 'oh yeah, we'll guarantee you that you have the workforce… but our institution can't turn out ten thousand workers for (the

business) alone.' So, I think what was positive is they strategically worked with the entire academic system in the state and came up with a way of the premier universities to train the trainers. The local community colleges and satellite universities train the workers. Because, you know, you had to set the whole system up. So, they proactively decided how to structure the workforce development and how each of the parts of the academic system in the state had unique roles in complementary roles." – Kevin

Although not specific to undergraduate engineering education, Kevin's storytelling brought up several important ideas related to ecosystem development. In larger-scale, system-level partnership activity, there often needs to be coordination across organizations to determine what is feasible in terms of outcomes and outputs from partnership activity. The point Kevin made is that structuring the workforce development components of this example partnership situation required 'proactive' decision-making around the roles each party played in the system being established. He continued:

"From a facility point of view, that worked great, but you know, these guys are working in class ten clean rooms, and not all the community colleges can have those. But what they did was then the capstone weeks, students would travel to (the business) to use their class ten clean rooms for the final certification, training, whatever they needed… I bring it up because I think that's an excellent way of a large university system, not a university, but a system understanding a huge need. (The business) coming in and figuring out from (their) point of view, what do they want, where my strengths are in my university system, and how do I respond as a system… So that to me is an example of what administration at a university can do to help their faculty understand, with the new demand signal, how they can partner to deliver on that demand." – Kevin

In this part of our discussion, Kevin was getting into the finer details of the partnership situation and articulating how, even down to the capstone project level, the system established by the partnership was integrated into education environments within the university and into the workplace environments of the industry partner. Kevin brought back the higher-level systems thinking about the partnership situation:

> "A university thinking at a system level, the system being the (location) region's academic system, not at their local level. I think the core of a lot of these is each university because they are centers of ideas. Usually focus on 'I can generate the idea to solve the problem' rather than 'I can generate part of the idea (such) that when I partner with others, it together solves the problem.' And in education and workforce training, I think this is an issue." – Kevin

The point that Kevin made is that there may be a degree of isolation of universities from the broader workforce systems, consequently leading to thinking in terms of problem-solving at local levels rather than larger systems levels that involve other non-academic entities. He continued:

> "It's driven by the federal government. For example, just poke a little bit at NSF (National Science Foundation). Every NSF grant has to have a workforce aspect to it. Absolutely the right thing to do, but what you end up doing is 'I have one hundred, one hundred- and fifty-thousand-dollar research grant with ten thousand going into education and STEM (science, technology, engineering, and mathematics) education. And then I got one thousand little projects all over the place.' None of them are coordinated. None of them are looking to do one plus one equals ten. And so, it's just a lot of noise. And not what I would call success or impact." – Kevin

In this part of the discussion, Kevin pointed to the potential influence of government funding priorities and processes on the isolationism of academia, also digging a little at the challenges with coordinating workforce development components of federal grants such that larger system challenges may be addressed. He went on to put this idea in more context:

> "Again, because I can't expect a faculty who's trying to run their own small business, right, because that's what they do to understand how to do research, to do technology transition, to do large workforce development activities, to do all and be on top of all the legal. I mean, it's just, a small company can't do it, right, let alone an academic, and so the way the policies are and the investments from the federal government, I think also drive some of these things. There's a lack of a coherent national education policy." – Kevin

What Kevin may have been suggesting is that some faculty members perform more roles than what is common to organizations outside of academia. For example, he mentioned that faculty often need to manage legal aspects of research and workforce development activities, which may be beyond the scope of expectations for their roles. From a systems perspective, there may be opportunities to coordinate across sectors and organizations such that the scope of work for a faculty member, or another individual, keeps them focused on generating value rather than dealing with processes outside of their typical purview. There is much conjecture in this discussion, but my intention in presenting this finding in this way was to articulate how at least one participant in my study discussed partnership strategies from a macro-scale perspective.

4.1.3 Summary of Findings

The first research question asked how external partners of universities describe antecedents to partnerships in engineering education. My results provide a detailed answer to that

question through how participants described their motivation to partner and their strategies for pursuing partnerships. ***Organizational motivations***, according to my participants and through my interpretation of their storytelling, include developing talent pipelines (i.e., recruiting students from the university into the company), branding (i.e., promoting the company brand as advertisement for potential recruits or the products and services offered by the company), generating value to the business (e.g., the outputs of a student project create commercialization opportunity or contribute to technology development), and benefiting from the 'fresh perspective' offered by students working with the external partners. Each of these findings has literary support but also contributes to literature in a unique way. Several prior studies suggest that access to students is a leading motivator of external partners (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Morell, 2014; Rampersad, 2015; Thune, 2010; Schaefer, 2022; Vuoriainen et al., 2024). My findings also provide insight into how this access can be a long-term strategy, influencing students' career choices over time. My findings related to the 'business value' sought by external partners extends what we know about the types of benefits external partners seek through partnerships in engineering education, well aligned with the research partnership situation (Thune, 2010) but less covered by existing research into the education partnership situation.

My study's findings related to ***individual motivations*** include the enthusiasm of company-internal employees to support student learning or recruiting at universities, which may or may not be the alma maters of the employees, and the personal passion of participants to have a positive impact on student learning and professional development through the learning and career opportunities afforded by partnerships. Existing research in engineering education does not provide as much insight into the motivations of individuals outside of academia to partner

with universities. My findings provide insight to help fill this gap in our collective understanding of motivations to pursue partnerships. The last finding in this section was categorized under motivation but has much less to do with motivation and more about presenting data related to motivation—how participants described ***what's best for students***. These insights included participants' ideas about curriculum change, such as the need for capstone-like experiences earlier in a students' academic journey, and the value of experiential learning opportunities for students, for example how they may benefit from real-world problem solving in teams. External influence on undergraduate engineering curriculum (Ankrah & Al-Tabbaa, 2015; Lamancusa et al., 2008; Morell, 2014; Thune, 2010; Vuoriainen et al., 2024) and the specific skills that students develop in their academic journey (Fleming et al., 2024; Lucietto et al., 2020) is a well-studied topic in engineering education. My findings contribute to this knowledge base and provide novel insight into specific types of curricula change and learning experiences desired by individual professionals who champion partnerships (i.e., my study participants) with universities on engineering education.

The second part of my response to the first research question included a presentation of findings related to the strategies employed by external partners for pursuing partnerships with universities on engineering education, as described by participants and through my interpretation of their storytelling. How participants describe ***which universities to partner with*** included discussion on research commonality between a university and an external partner as driving educational partnership activity, and how geographical proximity (i.e., the physical distance between a university and an external partner) is a key factor in these decisions on who to partner with. Education-focused partnerships as enabled by existing research-focused partnerships comes up in existing literature (Ankrah and Al-Tabbaa, 2015), and my findings extend the

understanding of specific strategies that connect these two, often distinct situations (e.g., participants in my study described connecting capstone projects to sponsored research activity between faculty and external partners). The relationship between geographical proximity and the antecedents to partnerships from the external partner perspective is less clear in existing studies of cross-sector partnerships in engineering education. My findings provide some insight into how proximity impacts the decision-making of external partners for pursuing partnerships with universities on engineering education.

I also presented findings related to ***partnership entry-points*** (i.e., where and how partnerships are established) and those included leveraging alumni networks (i.e., university alumni employed by the external partner have connections that can lead to establishing partnerships), and leaning on established structures and processes (i.e., traditional approaches like working with dedicated university partnership offices and personnel). Existing research provides insight into how alumni relations strengthen organizational relationships (e.g., Safrit, 2014), and my findings extend this body of knowledge with specific strategies offered by participants in my study (e.g., a company that designates 'ambassadors' to university partners who participate in student activities). Established structures and processes are the common model, and my findings provide insight into specific types of traditional entry-points to partnerships such as dedicated university liaison offices and personnel. I also brought in participants' perspectives on ***low-risk approaches*** to pursuing partnerships. Those include incremental partnership activities where experimentation is prioritized before moving towards higher-risk, more complex partnership activities. This finding is echoed in existing literature that talks about how partnerships are often formed incrementally through small-scale, low-risk

activities before working towards larger-scale, higher-risk activities (Perkmann & Walsh, 2007; Thune, 2010).

The last part of my response to the first research question was a disruption to the normal flow of my results. Rather than providing a topic summary with multiple participant perspectives highlighted, I chose to dive deeply into a single participant's (Kevin's) storytelling related to ***building ecosystems*** around workforce development initiatives. The findings in that discussion were about solving higher-level, systemic challenges and less concerned with the typical one-university, one-partner format of other discussions. Some of those findings include the need for convergence of capabilities from multiple sectors and organizations to address complex societal challenges, the need for coordination across those entities, and for that coordination to be supported (and enabled) by government intervention and incentive. The key takeaway from that discussion, which ties into some of the biggest ideas presented through these findings and assumptions of my research, is that organizations are better equipped to solve certain systemic problems (e.g., challenges posed by rapidly evolving competencies in engineering work) together rather than in isolation. This finding connects back to existing studies that shed light on strategic cross-sector partnerships (e.g., Ring & Van de Van, 1994; Thomas & Lancashire, 2010; Thomson & Perry, 2006; Wood & Gray, 1991). The contribution to literature from this finding supports the development of knowledge around higher-level systems thinking about partnerships in engineering education.

These topics and internal discussions collectively, supported by my dataset and generated through my own interpretative perspective, provide an answer to the first research question and offer rich, nuanced insights into why and how cross-sector partnerships in undergraduate engineering are formed. The takeaways from my findings (i.e., what the findings could mean for

different audiences) are presented in chapter five. What takes place throughout the process of partnering, from the earliest phases of forming partnerships (i.e., there is an overlap between antecedents to partnerships and partnership process) to the day-to-day execution of partnership activities is covered in my response to the second research question.

4.2 Research Question 2: Collaboration Processes

Developing an understanding of participants' experiences of collaboration processes is at the heart of this study. Recall from the literature review that theories of inter-organizational relationships cover a broad spectrum of theories related to interdependence and interaction between organizations (Ring & Van de Van, 1994). My study exclusively focused on the process dimensions of collaboration as proposed and described by Thomson and Perry (2006), validated by Thomson, Perry, and Miller (2007), and built on the foundational work of Gray (1989), to make sense of the collaboration processes found within cross-sector partnerships in engineering education. In this section, I address the second research question: **(RQ2) How do external partners characterize collaboration processes in partnerships?** I present my findings through the lens of Inter-Organizational Collaboration (IOC) theory and the *Five Dimensions of Collaboration*, interpreting participants' experiences and presenting an analytic narrative about the process interactions within cross-sector partnerships (CSPs) in engineering education through their storytelling.

4.2.1 Governance

"Partners who seek to collaborate must understand how to jointly make decisions about the rules that will govern their behavior and relationships; they also need to create structures for reaching agreement on collaborative activities and goals through shared power arrangements" (Thomson & Perry, 2006, p. 24). Participants in my study echo many of these ideas about

decision-making, developing working rules that govern behavior, and navigating shared power arrangements.

The governance dimension within the *Five Dimensions of Collaboration* of IOC theory is about the initial formation of partnerships where partners jointly determine who will make certain decisions, which actions can be taken, and how information and resources will be provided by each party (Thomson et al., 2007). Table 4 provides an overview of the concepts that were thematically derived from my data analysis along with abstracts that describe what the concepts convey from the dataset as related to governance and through my interpretation of participants' storytelling.

Table 4. Results Summary for the 'Governance' Process Dimension

	Concept	**Description**
Governance	Developing Situational Awareness	Partners' efforts to understand each other's organizational contexts, constraints, priorities, and decision-making rhythms.
	Recognizing Value Frameworks	Partners' efforts to surface and negotiate differing definitions of value so governance decisions reflect partnership priorities.
	Building Inter-Organizational Chemistry	Partners' efforts to learn one another's working styles and boundaries through open dialogue and negotiation.
	Communication Expectations	Partners' efforts to articulate clear goals, roles, responsibilities, and stakeholder-specific value stories when forming partnerships.
	Champion Roles in Establishing Governance	Partners' efforts to designate and support individual champions who act as intermediaries, translating goals and managing expectations.

The concepts shown in Table 4 do not define a linear progression of establishing governance in partnerships, although I have thoughtfully chosen the order of their presentation to reflect a linear way of thinking about these concepts in the context of CSPs in engineering education. These concepts can also be thought of as a collection of actions taken, non-linearly, by partners in the process of establishing governance. My interpretation of participants' experiences as they

relate to each of these thematically organized concepts provides the following insights into the governance of CSPs in engineering education.

Developing Situational Awareness. Recall from the literature review that cross-sector partnerships (CSPs) in engineering education often manifest as sponsored project activities (e.g., capstone design experiences in undergraduate engineering curricula) (Carbone et al., 2020), advisory board participation (Smith et al., 2018), guest speaking engagements (Burns et al., 2018), extensions from sponsored faculty-level research to undergraduate-level research activity, and other education-focused intersections of universities and external partners that take place within the purview of the university (i.e., the university has a degree of control over the student learning outcomes), per the scoping of my study. Several participants in my study talked about the situational awareness required to establish the working rules that govern behaviors and actions of partners—preceding the implementation of partnership activities. One participant described their experience developing an understanding of their university partner's situation:

> "(We want to) understand the school system itself. What's important to them? What are they trying to accomplish?... When we go in there, we identify programs, we look at what they're doing, how they're doing it. We then sit down with the faculty that want to engage, and we really listen to the pain points, listen to where they're headed, even their research that they're doing… we had to work with the faculty there at those four-year schools, make sure we're pulling in the right information. (Ensure) we've got the right (materials), right content, and again that was a lot of fact-finding and driving the collaboration between those." - Aarav

In this part of our discussion, Aarav indicated his desire to better understand his university partner's situation such as what they were trying to accomplish in their education programs, what

challenges they were facing, and what information and resources were needed to develop that understanding. Another participant echoed this point in a different way:

> "I would say understand your stakeholder first, and don't ask for money first. There's a whole institutionalized thing at a university that has to exist for that to happen. I understand they need money to survive. I get it. But if they understood our operations and who we are, they would understand we don't have cash like (other partners) … you have to understand who you're talking to… that's my main advice (to universities)." – Kevin

To Kevin's point, situational awareness is a two-way street. Both parties need to develop a strong understanding of each other's situations before decisions can be made to implement partnership activities (e.g., aligning funding and resources, as Kevin suggested). Another participant raised a similar point:

> "I would suggest that they find out what our needs are. What are our gaps? What are our needs?... Then engage us in a dialogue about the art of the possible and how they can support us." – Ramon

These participants' ideas about developing a situational awareness led to the thinking about developing working rules holistically where, as Kevin suggested:

> "What you need to do is identify a few areas where you can start down the road to at least illuminate the complexities, or illuminate some of the foundations that help strategic leaders and practitioners make better informed decisions… I think that's the noble goal that we need to shoot for." – Kevin

Illuminating complexities is what situational awareness is all about—a process of discovery and exploring the situations and conditions under which a partnership may be formed. The output of this process is a shared understanding that supports the development of working rules governing

behaviors and actions, as I interpreted through these participants' narratives. Another aspect of this process is recognizing (and respecting) one another's boundaries. One participant offered their thoughts on identifying boundaries:

> "We throw around the word partnership… one of my mentors said it's sort of a loose confederation of thieves… I love that analogy (and) really understood what he meant by that… (so) we're very careful with how we interact with each other, and we don't want to get too close, but we don't want to be too far away either." - Ramon

What Ramon described is his recognition that there are inherent boundaries with most partnership situations and that building those relationships is a continuous balancing act—making decisions about the nature of the relationship based on one another's boundaries. This may be particularly important for government organizations:

> "Just making sure that everybody is aware of the kind of relationships and the motivations and sensitivities I think is really key… we want to work with you on these things and here's some things where if these come up, we just can't because of the situation (of sensitive information)." – Kyler
>
> "I think that best practices, and this always has the potential to backfire, but being able to kind of communicate where you're at... Always helps if you have a good program manager within the (government organization) … and what that does is it reads the faculty member into the sensitivities of that organization." – Caleb

These participants, both employees of government organizations (recall the organization-type discussion from chapter three), described how the 'sensitivities' of their work have a direct impact on their relationships with university partners. My interpretation from their storytelling is that there may be firm boundaries for the flow of information and rules and procedures that must

be followed for these organization types. Developing an understanding of these boundaries supports the process of establishing governance in partnerships. The attention to the situations of partners, identifying and working with partner's boundaries, also blends into how partners recognize one another's value frameworks.

Recognizing Value Frameworks. My interpretation of participants' experiences that provided an answer to the first research question on antecedents to partnerships started to paint a picture of what value external partners seek through partnerships with universities (e.g., multiple participants' business-value motivations was a related finding for that research question). Organization-level variations are explored in the third research question, but with respect to collaboration processes, my findings indicate that different value frameworks influence the process of establishing governance in partnerships. Recall from the literature review that differing cultures and values are commonly cited as one of the greatest challenges in CSPs (Eddy, 2010; Gillen et al., 2021; Morell, 2014; Safrit, 2014)—universities are focused on educating students and industry on selling products and services (Morell, 2014). Based on what these prior studies claim, we might expect there to be conflict in the process of establishing partnership governance because of the differing value frameworks of universities and their external partners, which might also spill into implementation. There are three main types of values that I considered through my interpretation of participant experiences: business value, mission value, and gray areas. To conceptualize business value, one participant stated:

> "We don't have unlimited funds like Google does with their monopoly, you know, we have to justify what we're spending our money on." – Josiah

Recognizing that certain partners need to be able to communicate a return on investment (ROI), as described in my response to research question one, is an important part of building a

partnership and impacts the joint approach to establishing governance. Other participants echoed this idea:

> "The hard part sometimes is relaying appropriately the enthusiasm back to the people at your respective company. It's always going to go back to same thing. What's the ROI for us and how much is this going to cost?" – Joey
>
> "At the end of the day, someone's got to make money, and our (partners) just don't get that from the government side… we have to transition things to industry so that they're economically stable, so I can go buy this stuff someday." – Kevin
>
> "Everybody is governed and has to meet these quotas and expectations (internally), and it's all revolving around the money versus the value, and the impact." – Denver

These participants talked about what I call the 'business value' that needs to be present in the early discussions on partnerships because it provides clarity on how the relationships will be governed. For example, Denver talked about how partners may have internal expectations for partnership outcomes in terms of "money versus the value, and the impact," which may influence how partners negotiate on the benefits expected to be realized from partnership outputs (e.g., student project activity) in the early phases of forming a partnership. There are other value frameworks I considered as well from my dataset and analysis, such as those aligned with what I call 'mission value,' or the value placed on partnerships that extend beyond any one party's interests. One participant's storytelling captured this idea:

> "The key to success of really doing this right where I've seen it done well… (partners are) just as much vested in the development of the individual as they are of whatever program… the work is the person… spending time and energy to engage, evolve, and develop the person." – Micah

My interpretation of Micah's statement is that the value-thinking shifts from business utility, as previously discussed, to individual development where the goals for partnership are more focused on the impacts to individuals which Micah suggested is more important than quantifiable benefits to the business. Other participants offer mission-value type perspectives on working with universities in the early phases of forming partnerships and preceding implementation:

> "Everybody needs to walk away (from early discussions) with the value proposition from their point of view, which is one of the most important things, and then finding the motivation where whatever happens, all boats rise." – Kevin
>
> "Our charter is to work with industry and academia to bring the technology to the government. That is what we are supposed to do, so we don't have to have the sort of corporate responsibility, like that's part of it, but it's also our job which makes it a little bit easier." – Kyler

The process of establishing working rules involves 'negotiating an equilibrium' (Thomson et al., 2007) that attempts to align these differing value frameworks "at the margins and within a larger framework of agreement" (p. 25) into a cohesive and functional set of objectives. The process also helps to build rapport between the partners, or what I call inter-organizational chemistry, supporting the development of the working relationship that will be carried forward in the implementation of the partnership.

Building Inter-Organizational Chemistry. The metaphorical concept, inter-organizational chemistry, describes the quality of the working relationship being developed between partners. While there may be overlaps with other collaboration processes like mutuality, the emphasis of this thematic finding is on what takes place early in the partnership as part of establishing governance. Inter-organizational chemistry, as I define it, relies on the interactions

between the people, cultures, and systems of partnering organizations. Several participants offered ideas for how working chemistry can be established early on in a partnership:

> "It is sitting down and being open to hear a conversation, being open to understand why we're coming to the table… it's having that willingness to listen, to think outside the box and to put those preconceived notions to the side." – Aarav
>
> "The ability to understand your client, like where you got to meet them where they're at, right… trying to understand where different actions are coming from." – Caleb
>
> "You got to be willing to be open, to try to bridge across that gap so that the educational experience is meaningful for leading into what everybody's expectations are." – Alex

These participants described their desire for university partners to be 'open' to better understanding where they were coming from and to discuss alternative approaches to partnership activity beyond conventional ones. Alex continued to share his experience about why he felt this was important:

> "There are many other engagements that have occurred with other parts of (the university) where the willingness to collaborate is not present. There's certainly a perception of 'no, we know how to do this stuff, and we just need you to provide this piece,' and it's like okay, well… that's all you want from us, but that's really not what they need, and it doesn't help the students, and there's other ways to better integrate." – Alex

The idea of building an inter-organizational chemistry is inclusive of how collaboration practices are navigated early on in a partnership, as one participant stated:

> "Maybe we don't do it all. You know, don't eat the elephant in one bite here. Let's try a section or two (of a course) first… (or) let's do a workshop for them (students). Then deploy this in that course." – Aarav

The point that Aarav was making, when talking about a curriculum change for a particular course that he and his university partner were collaborating on, is that discussing experimental approaches and flexibility are desirable in the early phases of forming a partnership to reduce risk in the implementation. Another participant made a similar point:

> "I was developing this initiative on the (internal organization) side. Their (faculty) insights, their suggestions, their lessons learned, their best practices. All that stuff was being fed to me from an academic perspective… I was learning from them as I was building this system… this industry initiative that focused solely on working with academia was built with academia. We did not do it in a vacuum." – Denver

There is an ongoing negotiation and exchange of ideas in the process of developing the partnership that Denver was talking about—leading to my interpretative finding that learning from one another and collaborating on the parameters of the partnership are important for developing an inter-organizational chemistry. Other participants offered their ideas on negotiation in the early phases of forming partnerships:

> "Sometimes I have to say, okay, let's maybe one try something different. Just fly with me. Let's try something a little different. Sometimes they're open to it. Sometimes they're not. Or two, we can't do all of that… when you have all these things planned. So, it's curtailing it from that standpoint." – Violet

> "They (faculty) start by saying 'this is how we want to do it' (capstone) and then when we tell them how we would like to do it. They've always been very accommodating and

malleable in sort of adjusting it to the type of thing that we're trying to do (together)." - Haven

Thomson, Perry, and Miller (2007) talked about this process of "negotiating an equilibrium where contest and conflict between partners still occurs but only at the margins and within a larger framework of agreement on the appropriateness of jointly determined rules that assure a collaborative environment (p. 26)." These participants were talking about their experiences negotiating this equilibrium and an important part of this negotiation, based on my interpretation of participant experiences, is communicating expectations between partners and before partnership implementation.

Communicating Expectations. Expectations can change and evolve throughout a partnership. However, in the early phases of forming partnerships, such as negotiating the terms of a partnership, communicating expectations between partners is key to building trust between organizations (Morell, 2014) and leads to efficiencies in the implementation. Recall from the literature review that the differing needs and expectations of partners is often considered one of the greatest challenges faced in partnerships (Perkmann et al., 2013). Specifically, arriving at a shared understanding of needs and expectations is considered one of the most common issues in CSPs. These challenges can manifest as unclear benefits to partners or mis-aligned perceptions of success in the outcomes of partnerships. Participants in my study provided insight into communicating expectations through their experiences:

"The (university program) was very methodical in their presentations and our quarterly meetings with them, and so we always understood what the end goal was. They presented at every single meeting what is the end goal of this project." – Julie

> "I think that the (university) staff were pretty candid about what they were trying to do… when we're setting up these projects." – Mila

These participants described their appreciation for how their partners structured communications such that the goals of their respective projects were clear to all parties. Julie continued, offering more specific thoughts:

> "Let's make sure that there's contracts, understanding, what my involvement is… what exactly is my responsibility to the university and the students. That is definitely something I would like to know. So, there's no surprises." – Julie

What Julie described is her approach to ensuring she understands her partner's expectations for her involvement in the partnership, also indicating that predictability is desirable. Mila continued with her thoughts on communicating expectations, offering advice to other partners of universities that are considering partnerships in engineering education:

> "Start specific. Don't just go in and say 'hey, what do you got for us' because you might end up being dissatisfied with what they give back. But if you're saying 'hey, we have this need, we know you've got this group that does that', like go in with a plan." – Mila

This point was also made by another participant but in a different way:

> "There has to be a value story, if you will, about the quality of students, types of students, access to talent. That kind of structure will need to be put together… being able to tell a story about how their staff and facilities (at the university) are uniquely tailored to your business." – Micah

What Micah described also connects with the earlier discussion on recognizing value frameworks. My interpretation of this connection leads to the thinking that communicating expectations is like communicating the type of value you intend to receive through the

partnership, although this may be less inclusive of the roles and responsibilities often associated with expectations. It may also be important to recognize that the expectations of external partners are likely to differ, as one participant noted:

> "Understanding that our expectations are a little bit different than industry sponsored projects where those projects might be, and not always, but sometimes it might be 'well, we want someone to work on this to see where it goes,' but it may not have a very direct impact on the (clients) we work with. And so, expectations are fairly high on success of the projects, and I think that some universities do things a little bit differently." – Carla

Partnership champions, like Carla and the other participants in my study, play a critical role in communicating their employers' expectations to their university partners and developing an understanding of their university partner's expectations. This process, often facilitated by partnership champions, supports the negotiation of partnerships. Champions also play many other roles in establishing partnership governance that connect to all the ideas presented in this section, including partnership advocacy, ensuring clarity in goals, and navigating partnership stressors.

Champion Roles in Establishing Governance. Recall from the literature review discussion on the 'third space' of partnerships that one 'role of the champion' is to act as a boundary-spanner between organizations (e.g., Eddy, 2010). In establishing governance, champions (the term I use to refer to individuals serving as intermediaries of partnerships on behalf of their employers, whose titles can include project, program, and partnership managers) work across organizational boundaries to facilitate the formation, execution, and sustainability of partnerships (Veles et al., 2020). External partner champions, such as the participants in my study, play a critical role in shedding light on partner situations and value frameworks,

communicating expectations, and building inter-organizational chemistry in the early phases of establishing governance in partnerships. Participants in my study offered insight into how their roles align with this thinking:

> "I do think it's important to have those organic relationships. What I want (is) to make sure that whatever is happening, we can just track… On the organizational side, you have that POC… (someone) who is dedicated to the university." – Violet
>
> "You need to have roles (internally) that are dedicated to do this (build relationships with universities) … you have the right type of person who can, like Lego's, block it up and encapsulate it." – Haven
>
> "The PM (project manager) needs to understand what the (faculty), what the students and what the (programs) are trying to gain from all of this. If there isn't a mutual understanding and alignment… you're destined to fail." - Denver

As indicated by these participants, external partner champions ensure clarity in the process of establishing governance in partnerships, confirming what Veles and colleagues (2020) suggest and corroborated by other participants in my study:

> "Ultimately making sure that there's clear communication (between all stakeholders) throughout the entire process of deadlines, expectations, and needs on the project." – Carla
>
> "We sit down with the faculty, usually bring in the program manager on like a Teams call and say this is what you're going to be working on. So, everybody's on the same sheet of music and that we're all synchronized." – Sonny

External partner champions also advocate for their university partners and manage internal expectations in the early phases of forming partnerships, an idea less represented in existing research:

> "You definitely need buy-in (internally)… you need to convince the key and critical stakeholders that care about talent acquisition, that care about business development, community engagement, corporate social responsibility, and innovation... So, I really did convince them early on that there's opportunity here." – Denver
>
> "There's always an interest (internally) for us to do more, to hire more, to go to more places. So, I do have to curtail the expectations from some of our leaders to say let's think about this strategically… What universities, organizations and colleges make the most sense for our future workforce." – Violet
>
> "I can lobby on your behalf for you to be accepted as part of this (internal) program… Are you going to devote the resources?... And they did, and I lobbied for them." – Doug

In the next section on administration, the 'third space' of partnerships (as described in the literature review) is explored in more depth as it relates to the implementation of partnerships. But the role of the champion extends beyond advocacy and into the negotiation processes, including how agreements are discussed between partners on the distribution of costs, resources, and benefits—key steps in establishing governance. One participant described his organization's perspective on benefits sought in the initial negotiations with university partners:

> "We really wanted to have a quantifiable benefit you can point to and say 'yeah, that's why we did this project,' because here it is two years later and you know the outcome of it is in use, or it's apparent, or you know it led to something else." – Josiah

Another participant described one of the usual challenges in these types of negotiations:

> "The challenge is finding that sweet spot of work (where) the student feels very valuable and engaged and you know the company is receiving value out of it without risking, you know, essential business outcome." – Micah

The specific challenge that Micah talked about is brought up in a subsequent discussion on organizational autonomy as well—emphasizing the tension between the learning-focus of universities and the 'business value' (connecting to the earlier discussion on value frameworks) desired by the external partner. Partnership champions, like my study participants, play a critical role in navigating these tensions. There are also stressors described by participants in the early phases of forming partnerships with universities, such as negotiating rights to the intellectual property (IP) developed through partnerships:

> "There's a commercial issue that comes about… we want all the rights that you design and develop. The universities want some sort of royalty coming off the work that they've done. That seems to be one of the biggest headaches that we run into that tends to jam up partnerships with universities." – Dustin

> "Honestly, in the end we don't work with them as much as we do the other schools, or if we give them a project, it's not one where we're going to invent any IP, just because I can invent IP at (other university) and I know that I get all the rising IP, because I'm paying for it. Other schools don't do it that way, and whether they realize it or not, you know they're not getting project scope." – Josiah

The pricing models of student project activity at universities also came up as a stressor on external partners and champion representatives, discussed earlier on antecedents to partnerships because of the relevance to university partnership motivation and strategy. Partnership

champions play many distinct roles in establishing governance in partnerships, as these findings indicate, from negotiations to addressing stressors between organizational partners.

Participants in my study, who were partnership champions on behalf of their employers, described their experiences with establishing governance in partnerships through a diverse range of storytelling. Some participants placed more emphasis on tangible process elements like reaching agreements and negotiating rights to intellectual property and costs, while others emphasized the intangible process elements like communication, openness to trying new things, and relationship development. There is little prior research that explores this tension in emphasis in the context of collaboratively scoping student projects through CSPs in engineering education, and my findings contribute these types of insights to the growing body of literature on capstone design experiences and similar project-based learning experiences with external partner involvement. While there were some overlaps between the governance of partnerships and administering partnerships evident in my analysis and identified throughout related discussions, there were also several distinguishing characterizations of governance and administration, respectively, as interpreted through participants' storytelling and my analysis.

4.2.2 Administration

"Collaborations are not self-administering enterprises. Organizations collaborate because they intend to achieve particular purposes. To achieve the purpose that brought organizations to the table in the first place, some kind of administrative structure must exist that moves from governance to action. These administrative structures differ conceptually from those of governance because the focus is less on institutional supply and more on implementation and management—doing what it takes to achieve a goal" (Thomson et al., 2007, p. 26). The process-

shift in partnerships from establishing governance to implementation is what the administration dimension addresses—the 'nuts and bolts' of partnerships.

Participants in my study provided insight into structures enabling partnership implementation, the interfaces and protocols they felt do (and do not) lend themselves well to CSPs in engineering education. Their stories also helped to shed light on how operational frameworks are defined in related partnership situations, working with administrative constraints of each partner, and establishing roles and responsibilities of each partner. Table 5 provides an overview of the concepts that were thematically derived from my data analysis along with abstracts that describe what the concepts convey from the dataset as related to administration and through my interpretation of participants' storytelling.

Table 5. Results Summary for the 'Administration' Process Dimension

	Concept	**Description**
Administration	Implementing Partnership Interfaces	Partners' efforts to create and maintain multi-level interfaces that connect functional units and assign reliable points of contact.
	Leadership Roles in Partnership Administration	Partners' efforts to involve senior leaders as visible supporters who allocate authority and remove organizational barriers.
	Addressing Operational Challenges	Partners' efforts to negotiate and adapt operational processes of partnerships that conflict with organizational processes.

These concepts, presented as findings of my study in the discussions that follow, are limited to the data collected and do not necessarily cover every aspect of the administration dimension as proposed by Thomson and Perry (2006). For example, monitoring mechanisms are not discussed by participants in my study, although it is an important attribute of partnership administration. More discussion on how well my data and findings align to the *Five Dimensions of Collaboration*, as described by Thomson and Perry (2006), is presented in chapter five. My

interpretation of participants' experiences as they relate to each of the thematically organized concepts shown in Table 5 provides the following insights into the administration of cross-sector partnerships (CSPs) in engineering education.

Implementing Partnership Interfaces. Recall from the literature review that successful partnerships are often dependent on multi-level organizational support from both parties (Lucietto et al., 2020; Morell, 2014; Thune, 2010) and having organizational structures dedicated to supporting partnerships (Campbell, 2017). These administrative structural interfaces, established through collective agreement on the governance of partnerships, enable the implementation of partnership activities. Participants in my study described how implementing interfaces support partnerships, including the need for multi-level support structures and the challenges associated with individual-level interfaces. They talked about the multi-level support structures required to implement partnerships (i.e., the day-to-day operations), as one participant described:

> "You really need a top-down approach parallel with a bottom-up approach (for partnerships). So, you know, your (upper management) needs to support the vision and the strategy behind doing this… (and you need) the ones who are going to execute the work... You gotta have the right people in place… Your sales guys and your BD (business development) guys… They help shape and mold the outcome." – Denver

My interpretation of Denver's suggestion is that administrative interfaces should be implemented across organizational levels and non-linearly in the sense that these interfaces are not neatly scaffolded from 'top-down' or 'bottom-up,' but a combination of those traditional, linear approaches. It can take many different people to implement partnerships, as other participants noted:

> "There's been relationships that have going because of not just one person or one team maintaining those relationships. It takes a lot of different people. And I think not being in a silo and allowing multiple people to engage with the university… all the partners know who does what and who supports when… I think that's key, right, the more people and different people that engage (in) different ways." – Aniya
>
> "If you want to grow it (university partnership), you need to have multi-faceted relationships at different levels. Whether it's professors or department chairs and the Dean's office." – Ramon

Although the previous section on establishing governance placed emphasis on the role of partnership champions (i.e., individual intermediaries), participants in my study also talked about the role of others in their organizational and inter-organizational networks that were involved (or should be involved) in the implementation of partnerships. Some participants took this claim a step further in discussing their ideas about developing ecosystems through multi-level and multi-domain partnerships. Those insights were presented in my response to the first research question. Another participant offered a similar perspective on multi-level engagement to support partnerships:

> "Bridging kind of employers and higher ed together… employers may not have the right people or systems (and) mechanics inside to leverage the best partnership." – Aniya

Anyia presented the idea that these administrative interfaces may not exist in the early phases of forming partnerships (i.e., governance) and must be established in the implementation (i.e., administration). To accomplish this task of organizing or re-organizing administrative structures to implement the necessary interfaces, Aarav offered his thoughts on the process:

> "We gotta collect all the information. We gotta look at what's happening and then we gotta put all the players in place. But we gotta put them in a nice sequence and make sure that it's going in that sequence and there's a constant feedback loop." – Aarav

Another participant corroborated this point about putting the 'players in place':

> "For this type of effort… once we figured out that it (funding) had to come out of engineering… once we figured out the right people to get to, it wasn't too hard to get through the approvals and stuff." – Byron

The implementation of multi-level administrative interfaces also extends down to the activity level (e.g., interfacing with students), as one participant indicated:

> "I also know when we get really targeted in front of classes and tying into curriculum, I need the team members and business (people) to do that aspect. Because I can't talk about any of that to the depth of what students really want to learn. So, knowing the right stakeholders I think sometimes is the barrier in (working with) universities." – Aniya

These participants provided insight into why and how administrative interfaces play a critical role in the implementation of partnerships. Other participants approached this idea from a different perspective, one where there is a recognition that partnerships reliant on individual interfaces can face challenges:

> "Those (individual) relationships are very important, and you know if we run into a situation where like somebody we're working with at one of the schools changes out. And the person that replaces them, and this has happened, has not worked out as well then we consider pivoting from that person, and in some cases, that particular department to another." – Sonny

> "We had a trusted, interested, collaborative partner in (university) … when that participant left the university, that whole thing (relationship) fell apart." – Alex
>
> "We've had a pretty good pipeline from (university) in the past. But the advisor moved on. It's run by a different advisor now. So, I want to make sure we're maintaining that relationship." – Mila

What we can take away from these statements, in my interpretation and in reflection on the previous insights related to multi-level support, is that administrative interfaces in partnerships may be more sustainable as more connections are made between the organizations such that they are not person-dependent. Also, it may be advantageous to leverage existing organizational structures from both parties to create those connections in support of day-to-day operations. Having dedicated organizational structures for implementing partnerships is a recurring theme in related studies (Campbell, 2017). Several participants acknowledged that, beyond the individual champions, many partnerships benefit from leadership involvement within their organizations to support day-to-day operations.

Leadership Roles in Partnership Administration. Executive commitment and engagement are frequently recommended for cross-sector partnerships (Safrit, 2014; Eddy, 2010). Several participants in my study echoed the idea that, especially for multi-faceted relationships with universities, an executive who acts as the sponsor of the partnership on behalf of the external partner is often advantageous. Prior studies support this idea (e.g., Edmonson et al., 2012). These senior leaders may be better suited to individual-level interaction with senior university leadership than lower-level managers (often the organizational level of partnership champions as demonstrated by my study sample, discussed in chapter three). Participants discussed their ideas about leadership roles in partnership administration:

> "Drive engagement from the top. Assign an executive champion… grab some other (internal) people… that recipe actually worked really well (for us)." – Micah
>
> "The reason it was different for us is because (organization), at the executive level, was supportive of (us) having people present to help make the educational experience better for the students… help create an interface back to the organization (which) evolved into (us) having a bigger participation." – Alex

What Alex pointed out for his employers' situation is that having an executive of the company who is supportive of the university partnership may have positive downstream impacts on the activities of the partnership (e.g., improving the educational experience for students as indicated in his statement). Other participants corroborated this point:

> "You have to have an executive who is the sponsor of the relationship… once you (do), things fall into place from there. When I say things, I mean we'll have somebody who's making sure that we have our quarterly meetings. The Deans are all there and the different (organization) leaders are there, and they talk about what's happening what's upcoming." – Josiah
>
> "One of the criteria is that we have a senior executive that really wants to make this relationship (work). Otherwise, the inertia of the organization will just crush the initiative." – Ramon

Ramon also mentioned the idea that even though these partnership activities are happening linearly, they are taking place in parallel with the typical workflow of an organization. This idea of divergent workflows (i.e., the normal workflow of an organization and the separate, distinct workflow of a partnership) is also a recurring theme in related studies (Perkmann et al., 2013).

There is a cadence for how senior leaders of external partners should be involved in the partnership, too, as one participant suggested:

> "To have an effective partnerships, you gotta have the leader, and you gotta have the cadence of meetings with the right people in it." – Josiah

However, there are also competing ideas about executive support and involvement in partnerships, consistent with what was discussed in the literature review (e.g., Thune, 2010, suggests that top-down leadership is not always the best solution because of the differing levels of autonomy with an organization), as one participant described:

> "Maybe because they were not an alumni, (but the executive sponsor) took a pretty hands-off role. They signed the checks. They came to campus and shook some hands. They would resolve issues. But I basically ran the activity and set the strategy." – Doug

This 'symbolic leadership' type of approach to leadership roles in partnerships is also pointed out by another participant:

> "The fact that you are engaged with the university is a recognition that is available to executives and management personnel as a way to feather their cap, but they don't really do anything. Well, that's the wrong approach, too." – Alex

The findings presented in this section on leadership roles shed light on the variation in perspectives offered by participants in my study but also brings forward some consensus around the multi-level support often required to implement partnerships. Another set of findings relevant to the administration process dimension provides insight into how external partners address operational challenges in the implementation of partnerships.

Addressing Operational Challenges. In establishing governance, the findings of my study pointed to understanding partners' situations, needs, and expectations, recognizing values,

and building individual relationships. The administration process dimension is about the actions taken based on the established governance, to implement partnerships. What the literature review did not cover as well, because of limited prior research, is the day-to-day management of partnerships such as the specific administrative procedures to be followed by each party and how those manifest throughout the partnership lifecycle. Participants in my study helped to fill this gap by providing insight into some of the operational challenges they have experienced in CSPs on engineering education, such as navigating legal and accounting procedures. Several participants discussed their perspective on protecting intellectual property (IP) and the rights to IP generated through partnerships:

> "At the beginning, making sure we sight the right contracts and NDAs (non-disclosure agreements) is important." – Josiah
>
> "If there's proprietary things that you've developed that you feel you need to protect, then you can go protect those… If you told me that (competitor) is gonna hear about my data, or something like that… We always get a little bit nervous of what we're sharing (with universities)." – Dustin
>
> "Contracts and legal is so important. IP, licensing, export control, like really getting ahead of that and understanding all of it. All of it in the beginning is super important." – Denver

These participants indicated that protecting information, often through formal agreements, is a necessary part of partnership administration. While we may expect that need to surface in research partnership situations (Perkmann & Walsh, 2007), these data also point to the relevance within education partnerships. For example, in an earlier discussion I talked about how capstone

pricing models vary depending on the university and program, and participants in my study offered additional thoughts on the costs associated with typical capstone-focused partnerships:

> "The capstone marketplace is very bizarre. So, a lot of capstones are zero cost. Okay. And some capstones go up to like a hundred and fifty thousand dollars. That's the engagement fee. So, it's very like wild west as far as what's going on with the pricing." – Haven

> "Unfortunately, we haven't been able to even really explore it, just due to the cost that the university was looking for us to pay them to do that particular project. So, I would say, that's maybe where sometimes, you know, it's a stall, especially when a small nonprofit like mine is trying to get some impactful work done is the cost that is involved… Universities are all kind of like all over the place in regards to what they charge for different projects." – Julie

In my interpretation of these participants' narratives, there may be a relationship between the pricing models of capstone projects and who will own the rights to the IP generated through partnership activity (i.e., the outputs of the capstone projects), although these participants did not directly describe any such relationship. However, it may be a reasonable assumption that high-cost project sponsorships are more likely to provide these types of benefits to the sponsoring organizations (e.g., retaining all IP rights), and more likely to be withheld by university programs for low-cost project sponsorships. The situations vary and other participants indicated that they may be less concerned with IP rights and more focused on the administrative procedures that need to be followed to protect sensitive information disclosed through the partnership activity:

> "The administrative red tape and the level of scrutiny on any sort of contract that requires external authority, like the government customers authority. You know, there was this

need to justify why… this group versus some other university... I couldn't make the argument for funding a capstone. Just kind of the limitations of the type of work that we can do with that color of money is a challenge." – Mila

"If the intelligence community is funding an activity at a university, you have to have the approval of the university administrator. They acknowledge that they are getting funding from the intelligence community… we had to go figure out who it was that we needed to notify… what we have to go through to work with these universities." – Kyler

These participants, both of whom represented government organizations, pointed out the administrative procedures required to do project work with universities, which may be unique to each situation. What may be most important for university partners, through developing situational awareness in the early phases of forming partnerships, is recognizing these types of constraints when working with government partners. Even how sensitive information is communicated outside of a partnership can be a constraint, as one participant indicated:

"I see a lot of relationships ruined by ignorance or inability to communicate on both sides when it comes to (public release of information) … Nothing will kill a program or an effort faster than publicizing it the wrong way." – Caleb

Another operational challenge that participants suggested needs to be addressed in partnerships with universities on engineering education deals with accounting. Often, there are transfers of funds from external partners to universities as part of partnership agreements (e.g., capstone sponsorship often requires a fee). While some participants discussed their frustrations with the variation in costs associated with certain partnership activities, several others noted the operational challenges in the implementation with transferring funds:

> "It amazes me still to this day. I've been in industry (many) years. It seems like the hardest thing to do sometimes is send money to people." – Kyler
>
> "We haven't actually been able to pay them the money yet. So far, it has just been a headache on our side. They've been great. They've been pretty flexible." – Mila
>
> "One thing we need to break, which is very difficult for us because it's just tied into taxes, is the way we provide money to the university… is just a very inefficient, slow, bad process." – Alex

This point was echoed by other participants in my study as well, although less directly. Often, the challenge is aligning the payment processing windows between the two organizations and ensuring that funds are transferred in a way that satisfies both the external partners and the university's respective accounting procedures. Another participant offered their thoughts on this challenge:

> "There's been a lot of scrutiny on how funds are spent… timely expenditure of funds to show that the money we're sending you is being used for the purposes that we agreed for it to be used and at a rate at which demonstrates that it will all be expended at the time it needs to all be expended by. Because all these funds that we provide to the schoolhouses have a period of performance window which you can use it and by law after that period of performance (PoP) window, that PoP date expires and the funds are not spent, they can't be expended anymore. They need to be sent back to billing." – Sonny

Sonny indicated that in addition to the accounting procedures, another constraint is ensuring that funds are used for their intended purposes. These accounting procedures can create stress on a partnership as well, as another participant suggested:

> "One thing that happened that almost screwed up an entire relationship was just the accounting and the invoicing, depending on the academic institution… They're not thinking about invoicing nor accounting… the university hasn't invoiced somebody in four months. Well, guess what happens. Industry gets this. (We) get an invoice in February of 2026 for work that was done in 2025. Well, the government doesn't like that." – Denver

As Sonny and Denver noted, the alignment of payment schedules can be challenging when working with universities, even to the point of jeopardizing the overall relationship between the organizations. The partnership champions are not typically the ones directly handling the financial aspects of the relationship, although they can be the ones acting as brokers (i.e., they are often the ones who negotiate and agree to the amount of money to be transferred to their university partner). These topics on aligning legal and financial procedures are less covered by existing literature, and my findings support a stronger understanding of administrative challenges associated with CSPs in engineering education. One final challenge that I chose to include in these findings deals with aligning partnership activity timelines with external partners' timelines, as one participant indicated:

> "Especially when you're involving students, you create another hurdle because the academic year for universities does not change. It's set in stone… That is one of the more frustrating things when working with universities." – Caleb

Although competing schedules of partners is less covered by prior studies, it may be reasonable to assume that private industry organizations, government organizations, and universities don't often share the same types of timelines for their operations. My findings provide insight into how this type of conflict can manifest in CSPs in engineering education.

Through these discussions, participants in my study described their experiences with implementing structures and interfaces in partnerships with consideration towards a variety of administration-related topics. Some participants placed more emphasis on the role of an executive sponsor than others, and on the types of partnership interfaces they feel enable successful partnerships. Distinct types of operational challenges were also presented. Although several of these ideas share similar features to topics presented in the section on governance, there are certain distinctions. For example, developing situational awareness can include initial negotiations on IP rights, but finalizing and instantiating the terms to be followed is more action-oriented and better aligned to partnership implementation (i.e., the administration process dimension). Throughout these structural-dimension discussions on governance and administration, I presented points of potential conflict and relationship stressors that can create challenges within partnerships. The next topic, organizational autonomy, explores these tensions explicitly at the intersection of organizational self-interests (i.e., what external partners seek to provide and gain from partnership) and collective interests (i.e., what is agreed upon for the partnership and how costs and benefits are distributed).

4.2.3 Organizational Autonomy

"A defining dimension of collaboration that captures both the potential dynamism and frustration implicit in collaborative endeavors is the reality that partners share a dual identity: They maintain their own distinct identities and organizational authority separate from a collaborative identity. This reality creates an intrinsic tension between organizational self-interest—achieving individual organizational missions and maintaining an identity distinct from the collaborative—and a collective interest—achieving collaboration goals and maintaining accountability to collaborative partners and their stakeholders" (Thomson et al., 2007, p. 26).

The tension between what external partners of engineering education desire to gain from partnering with universities, and what the partnership can provide them in terms of those desired benefits, was the focus of my exploration into 'organizational autonomy' as interpreted through participants' storytelling. A study that considered both partners' perspectives would also explore the tension from the university partner's situation, but that was beyond the scope of my central research question. However, participants in my study provided some insight into organizational autonomy within the university, from their perspective, and the potential impact on their partnerships. Participants also described the tension between what they seek to gain from the partnership and what they agreed to in support of collective goals. Table 6 provides an overview of the concepts that were thematically derived from my data analysis along with abstracts that describe what the concepts convey from the dataset as related to organizational autonomy and through my interpretation of participants' storytelling.

Table 6. Results Summary for the 'Organizational Autonomy' Process Dimension

	Concept	**Description**
Autonomy	Tension Between Tangible Benefits Sought and the Emphasis on Learning	Partners' efforts to negotiate scope, calibrate expectations, and align with university constraints in pursuit of a positive return on investment.
	Challenges with University-Internal Relationships	Partners' efforts to navigate internal university misalignments on performance expectations, capabilities, and decision horizons.

These concepts, presented as findings in my study in the discussions that follow, are limited to the data collected and do not necessarily cover every aspect of the organizational autonomy dimension as proposed by Thomson and Perry (2006). For example, "intractable problems that partners cannot solve on their own" are not explicitly discussed by participants in my study because of the unique situation of CSPs in engineering education and the complementary nature of the exchanges that take place in that context. The concept of 'identity shift,' where

organizational identities are at risk when the partnership goals conflict with external partner goals, is also not addressed in my findings because participants in my study did not speak directly to this concept.

Tension Between Tangible Benefits Sought and the Emphasis on Learning. In an earlier discussion on value frameworks (governance dimension), my findings pointed to the need for university partners to recognize what type of value external partners seek in partnerships and vice versa. From the organizational autonomy perspective of IOC theory, participants in my study described tensions present in partnerships when their focus was on project outputs generating business value and their university partner's focus was on the student learning experience. For example:

> "The challenge is finding that sweet spot of work (where) the student feels very valuable and engaged and you know the company is receiving value out of it without risking, you know, essential business outcome." – Micah
>
> "If we're talking undergrads like, yeah, they might be doing something that moves the needle, but probably not. You know, they're kind of more focused on (the) learning." – Caleb

These participants described their recognition that although they seek a particular type of project output or benefit through partnerships, they had to adjust their expectations to what was feasible given the situation of their university partners and the students involved—there was a tension evident between what their initial expectations for the partnership and what was ultimately agreed upon. Recall from the literature review that these types of tensions are often cultural—industry (i.e., external partners) places more emphasis on tangible outputs that have business relevance (Morell, 2014) and academia places more emphasis on intangible outputs such as

learning (Schaefer, 2022). This dichotomy may not be the case in every university partner situation, as another participant pointed out:

> "Some universities do things a bit differently. With some the expectation is the experience. What they (students) produce may not be as important as the experience and the skills they gain versus other universities, where it is very much on what they produce at the end of the project. I think, understanding those differences between student experience but also student production at the end, and what we get at the end has to be usable for the client at the end of the project." – Carla

What Carla suggested is that these tensions may often be inherent to the student project sponsorship situation, and understanding how this tension shows up in each partnership situation helps the partners to reach consensus on project objectives (like the points made in the 'collaborative scoping' discussion earlier but from a different perspective). There are also competing ideas about who is seeking which types of value in these types of partnerships, as another participant noted:

> "The hard part is, you know, universities are really looking at research dollars and they're really trying to bring in money and funding. And that's not what we're about. We're about (enabling) students to become better at the skills and abilities." – Aarav

Aarav pointed out that for his employers' situation, they were more focused on the student learning experience and viewed his university partners as seeking more tangible outputs for student project activity. This narrative contrasts what prior research and my findings in this study suggest. Regardless of which partners seek which types of value, my finding related to organizational autonomy is that there is likely to be conflict between what each partner seeks through partnerships and what is ultimately agreed upon in support of the collective interest.

Along the same vein as conflicting goals, participants in my study also talked about what is feasible, in terms of partnership outputs from activities like student projects, to expect from the students based on their experiences and skillsets. It is common for these constraints to be outside any partner's control, given the variability in how students come together to form a project team. Prior studies suggest that external partners may feel, at times, that students are not skilled enough to deliver results that meet their expectations (Conradie et al., 2016; Goldberg et al., 2014). The misalignment between external partners' expectations and students' capacities to meet those expectations creates tension between external partner interests and collective interests, as one participant indicated in terms of risk:

> "I would also say risk is that students don't have the skills to actually do the work that needs to be done. It's one thing when you're in the corporate world and you're like, yes, I have this person whose been doing this for fifteen years. They're going to be able to answer my question. You're kind of taking a risk when it's people new to the area, especially because I don't have control over what specific individuals are assigned to a project." – Mila

Adjusting expectations in reaction to this tension, to satisfy partnership objectives, is evidenced through my interpretation of several other participants' experiences:

> "On our end was just adjusting to the fact that especially for these undergrad projects. These are students. So, scoping the project to something that students can reasonable accomplish… (and) we're scoping our expectations appropriately." – Kyler
>
> "Sometimes you'll give them a task that requires more engineering than they can handle, because they don't have the right team for that. And you try to take that into account when you give them the task. But sometimes, you know, the task is the task, and they're

unable to make progress that we wished just due to a lack of talent on the team… They might need to really hit it out of the park. Instead, we get a single." – Josiah

"That was through the undergrad student level. And that was a bit of a struggle to be honest, working with students who were, I think, really green." – Julie

This finding deals specifically with how participants describe the tension between self- and collective-interests when negotiating student project scope, overlapping with an earlier discussion in the governance section which was more about the activity of scoping and less about the tensions found within that process. Recall from the literature review that Campbell (2017) suggests there is often insufficient effort to clearly define scope and goals of partnership, and so I suggest that these tensions are necessary, and partners benefit from intentionally working through them even down to the student project scoping level of activity for those types of partnership arrangements. It would not be a reasonable assumption that all related university programs handle these processes similarly, which is also supported by the subsequent finding that external partners characterize organizational autonomy in terms of the challenges posed by variation between programs within and across universities.

Challenges with University-Internal Relationships. Although my study only considered the external partners' perspectives on partnerships and collaborations processes within them, what I discovered in the data analysis was perspective, through the participants' experiences, on university interests that may conflict with collective partnership interests. There is a tension to be explored in their storytelling about how universities vary in terms of managing external partnerships, and vary internally across colleges, departments, and programs within a university. This tension shows up as a challenge, as one participant suggested:

> "I do see some barriers that if, you know, the school isn't as robust in their internal relationships, inside their own universities. Sometimes that's the barrier." – Aniya

What Aniya suggested is that university-internal relationships, which we can think of as partnership coordination capacity in the context of her story, may have an impact on partnerships and the collective goals of partners. The literature review did not include insights into how external partners perceive university-internal relationships because existing studies related to CSPs in engineering education did not provide them. My finding contributes to this growing field by developing such insights. Other participants offered similar thoughts on this topic of university-internal variance:

> "The (university admin) were supportive of this activity. But then let's go down into the colleges and actually put the classes in place. Then you start to run into people that are like 'no, we don't need industry to be involved, we don't need your help.'" – Alex

Alex pointed out that his university partners at higher organizational levels were supportive of activities he found favorable to the partnership, but then there was tension between those supports and lower organizational levels where the implementation of those activities was anticipated. This type of perspective from Alex was the only one offered by participants in my study, and I chose to include it in this section to emphasize my finding that within a university there may be autonomy at different organizational levels that can create tensions impacting partnerships. Another participant talked about how differences between programs within and across universities can be challenging to navigate:

> "One of the things that's really hard… within these universities. All the departments are different. They're run differently. And a lot of that is personality driven, But there's just no, you know, boilerplate template for how that's supposed to go." – Caleb

> "It is way different within the university. Like, I could partner with one department of engineering here and it would look totally different than any other school… There's no academic standard for structuring the relationships. That's just not what they're worried about." – Caleb

What Caleb suggested echoes the earlier point that autonomy within the university can create challenges for external partners, where tensions between self- and collective-interests vary between each context and situation even down to the program levels. Another participant offered broader insight into the university-internal autonomy tension:

> "I think the core of a lot of these (systemic challenges) in each university, because they are centers of ideas and usually focus on 'can I generate the idea to solve the problem' rather than 'can I generate part of the idea, that when I partner with others, it together solves the problem.'" – Kevin

Kevin's narrative in this part of our discussion follows a similar line of thinking to the 'ecosystems thinking' discussion earlier on partnership strategies, providing insight into a systems-level thinking about organizational autonomy in cross-sector partnerships. Josiah made a similar point:

> "The thing that they (universities) are the worst at is thinking about the five plus year future. They're very good at thinking 'what I got to do this year and next year' and even the year after that. But you ask anybody, what's your plans for five years from now. They don't have any, like, 'I will get to that two years from now, you know when it's only three years away, and then we'll worry about it. I mean, it's literally that short-sighted and when they do put together a plan of what to do, they get to about five years out and

they say, 'whatever that thing is, we're just going to keep doing that, like, for eternity.'" – Josiah

Although what Josiah suggested may be better aligned with a discussion on culture conventions of academia, it raises a similar point to what Kevin talked about—the isolationism and near-sightedness of organizations can create tension between what one partner seeks to accomplish through a partnership over time and what is feasible for the collective. These findings, collectively, offer insight into organizational autonomy through CSPs in engineering education, although as I noted in the limitations section of chapter three, my dataset did not provide strong coverage of this process dimension relative to others and as proposed by Thomson and Perry (2006). These process dimensions offer a degree of linearity (i.e., how partnerships are formed through governance, then implemented through administration) and following this discussion on tensions between self-interests and collective-interests, I present findings related to how these tensions can be mitigated and addressed in partnerships.

4.2.4 Mutuality

"Organizations that collaborate must experience mutually beneficial interdependencies based either on differing interests —what Powell (1990) calls "complementarities"—or on shared interests, which are usually based on homogeneity or an appreciation and passion for issues that go beyond an individual organization's mission" (Thomson & Perry, 2006, p. 27). The process-shift in partnerships from navigating tensions between self-interests and collective-interests to resolving tensions through negotiation to arrive at win-win outcomes is what the mutuality dimension addresses—recognizing that partners can accomplish more together than independently (Thomson et al., 2007).

Participants in my study provided insight into how mutuality was demonstrated in their partnership experiences. Through my interpretation of their storytelling, I present findings aligned to the mutuality-dimension of IOC theory. Table 7 provides an overview of the concepts that were thematically derived from my data analysis along with abstracts that describe what the concepts convey from the dataset as related to mutuality and through my interpretation of participants' storytelling.

Table 7. Results Summary for the 'Mutuality' Process Dimension

	Concept	Description
Mutuality	Enabling Goodwill Relationships Between Partners	Partners' efforts to recognize and respond to each stakeholder's needs and informal priorities to work through differing interests.
	Anchoring Partnerships on Shared Foundations	Partners' efforts to articulate and foreground common values and a shared interest and commitment to supporting student learning.

These concepts, presented as findings in my study in the discussions that follow, provide coverage across the two central ideas that Thompson and Perry (2006) propose for the mutuality dimension: mutually beneficial interdependencies based on differing interests (i.e., partnerships are formed through negotiation on differences) and based on shared interests (i.e., partnerships are formed through similar missions or a shared commitment to target populations). My interpretation of participants' experiences as they relate to each thematically organized concept in Table 7 provides the following insights into mutuality within cross-sector partnerships (CSPs) in engineering education.

Enabling Goodwill Relationships Between Partners. I define goodwill as an intangible asset representing the value of a partner's name and reputation. Recognizing what each partner seeks to gain or achieve, beyond stated goals, through partnership is a critical step towards

enabling goodwill to be shared between partners. The term 'accommodation' is often used to describe this idea of adjusting self-interest goals to satisfy the needs of a partner (Thomson et al., 2007), for the good of the partnership. I associate accommodation with demonstrating goodwill in the context of this discussion. Participants in my study offered their ideas related to accommodation:

> "Our hope is that we're trying to set up this win-win mindset for everyone (with capstones). What do we feel is in it for students? What do we feel is in it for universities? And what do we feel is in it for (us)?" – Haven
>
> "What I think is really cool, at least from what I'm seeing, is that (partners) are kind of pushing each other forward. So, the industry we're in is changing and evolving… (and) it's happening both ways." – Carla

Although these participants did not speak directly to adjustments made for the good of a partnership, their narratives indicate how they think about enabling goodwill relationships in partnerships through accommodation (e.g., recognizing partners' goals and the mutual advancement of goals). Another participant offered their ideas on how goodwill relationships can be formed:

> "We're going to provide a different value to you all than trucks full of money, because we don't have that. And (university partner) especially just really always understood that. And he's like, you know, you are giving us insight and access into this customer environment and these customers that our students would never come across and helping inform what we teach our students." – Kyler

My interpretation of these participants' storytelling is that recognizing the types of value created for partners, beyond their stated goals, supports goodwill relationship development. Often, this

type of relationship development takes place at the individual (e.g., champion) level, as one participant suggested:

> "I would say the (partnership) required some gifted individuals to lead it and execute it. Really be a servant-based leader and please all parties all the time. To make it happen, you need those things on the industry side. And then you also need something to invest in academia. You need money, but you also need relationships." – Denver

The role of the champion in partnerships is a recurring theme in literature and my study findings. These individuals, such as the participants in my study, often transcend functional boundaries to develop relationships at inter-organizational and interpersonal levels (Veles et al., 2020; Sjöö & Hellström, 2019; Adams & Lanford, 2021). They function as a cultural bridge, translating across boundaries (Edmondson et al., 2012), a point echoed by another participant:

> "So, I think that's one thing. Intermediary. Translator. How do we get the right translation from business to the universities, and then from the universities to the business. We need that intermediary translator." – Dustin

What this means in the context of this discussion, in my interpretation, is that through these individuals' efforts to bridge culture and facilitate relationship development, accommodation is more likely to occur, enabling goodwill relationships to be formed between partners. Working through differing interests (i.e., the tensions between self-interests and collective interests, as discussed earlier in the organizational autonomy section) is easier through goodwill relationships (Thomson et al., 2007). Bridging cultures in the interest of enabling goodwill relationships includes bridging languages, as the organizations involved in CSPs in engineering education often have distinct ways of communicating. For example:

> "The language has to be written in a way that industry can digest… academia has to understand that and vice versa, industry has to understand that academia has requirements… we've come a long way in getting all of those key and critical stakeholders to understand the other side and get all parties to understand that we really want to do this (build an ecosystem)." – Denver

Reflecting on the earlier discussion on 'ecosystem development' in the partnership strategies section, building community around shared challenges is another way to enable goodwill relationships in partnerships. Kevin (the 'star' of that discussion) offered his thoughts on building community:

> "At the end of the day, we need to synthesize the community and so we're very bullish on partnerships. And when I say partnerships, that means partnerships of equals to forward the solution by mutually dependent contributions. To do that, we do a variety of things to generate those ecosystems." – Kevin

Mutual dependency is a core concept of mutuality in the context of inter-organizational collaboration (Thomson et al., 2007). Recall from the literature review discussion on partnership continua that interdependency is likely to increase along the continuum from cooperative to collaborative types of organizational arrangements (Keast et al., 2007). In my interpretation of participants' experiences, we can also think about this linearity in terms of the transactional to strategic partnership continuum (recall that discussion in the literature review), where developing community around shared challenges and increased levels of interdependency are more likely to be found at the strategic end of the spectrum. One participant's narrative may support this idea:

> "The conceptual scheme that we use is we don't want it to be a transactional relationship. So, our idea isn't, we're coming to the table giving something and expecting something

in return. So, that's the mental model we want to remove from the student engagement experience. So, what we're looking to do is we're looking to build a community." – Haven

These participants, collectively in this discussion, paint a complex picture of how accommodation and community building enable goodwill relationships to be formed. There are several overlaps with ideas from the antecedents to partnerships findings (e.g., individual enthusiasm and personal passion may support developing goodwill relationships) and governance findings (e.g., building inter-organizational chemistry may support this process), but the collective narrative helps to inform how participants in my study offer specific insight into resolving organizational tensions and conflicting interests through mutually beneficial relationships. The next topic further develops these ideas and considers more explicitly how common values and shared interests can help anchor partnerships in ways that enable mutually beneficial exchanges between partners.

Anchoring Partnerships on Shared Foundations. In the introduction to this section, I mentioned how mutually beneficial interdependencies between partnering organizations are often based on differing interests, necessitating accommodation, or based on shared interests, leveraging a common appreciation or passion for issues that transcend the organizations (Thomson & Perry, 2006). The former discussion on enabling goodwill relationships addressed the differing-interests perspective through participants' narratives on accommodation (towards developing what I refer to goodwill relationships) and the role of the champion, and community building through mutual interdependencies of organizations that may not share a common culture, language, or core values. The following discussion addresses the shared-interests perspective. Several participants in my study talked about commonalities in values and shared

goals for supporting students' learning—core concepts within the mutuality process dimension (Thomson et al., 2007). Concerning common values, one participant stated:

> "I want to work with people who want to solve the problem. We'll figure the cash out later. If I find people that can solve the problem. Good problems. Good people… the development in the workforce will flow from that." – Kevin

My interpretation of what Kevin suggested is that emphasis placed on the shared challenges of partners, rather than other types of emphasis such as business value as discussed earlier, is an enabler of mutually beneficial relationships. A participant suggested another enabler:

> "The key to success of really doing this (partnership) right, where I've seen it done well, have been when the industrial institution is just as much invested in (the) development of the individual as they are of whatever program." – Micah

Although what each of these participants talks about differs, the shared idea (i.e., finding) is that common values between partners enable mutuality. The greatest enabler cited by participants in my study was the shared interest in supporting students—their learning and professional development. Several participants offered their perspectives:

> "Anyone who works in the university environment and supports students. Our jobs are to support the students to ensure (everyone has) the best interest for students… To learn what they wanted to do, what they wanted to explore, what types of roles and skills would best align with their academic pathways." – Aniya

> "So, at the individual level, what I look for is based on my experience and what I've seen others is a partner at a university that thinks of their student development first and foremost… As much interested in where the student goes and the capabilities of that student as they are in (other outcomes)." – Kevin

> "The other thing that made it successful was the students are developing skills that are highly relevant not just for (us) but in the broader industry… So, I view it as being really successful and that it gave those students some really marketable skills." – Mila
>
> "I think they (partners) all have that same DNA in their blood, right. They show that passion, that show that enthusiasm for creating the best student." – Joey

These participants provided insight into their core values related to CSPs in engineering education—aligned with what we might expect from the university side for prioritizing student learning. One participant, tying back into the 'personal passion' discussion in the motivations section, expressed that supporting students is personally rewarding:

> "Working with the students is always enjoyable. Right. I mean, they're working on a campus. They're little sponges and they come up with stuff where you're just like 'damn, you're so much smarter than me,' and that's a great moment where they do something that you couldn't have and you helped bring that to (us), or whatever your company is right, by doing the project. So, you know that moment when they surprise you with their level of savviness and expertise and knowledge." – Josiah

Another participant shared a similar sentiment, also bringing in how this shared interest in student learning overlaps the 'what's best for students' discussion from the motivation section:

> "In my perception, there is certainly a gap between what we teach and what (students) need to know to survive in the real world. And you got to be willing to be open, to try to bridge across that gap so that the educational experience is meaningful." – Alex

Each of these perspectives on common values and supporting students offers insight into how participants in my study describe mutuality through their partnership experiences. Social capital resources, like mutuality, are often cited as more important to partnerships than the tangible

outputs of partnerships (Keast et al., 2007; Kezar, 2005)—supporting relationship development that can lead to building trust, respect, and commitment (Thune, 2010).

4.2.5 Norms of Trust and Reciprocity

Norms of trust "is a common belief among a group of individuals that another group will: (1) make ''good-faith efforts to behave in accordance with any commitments both explicit and implicit,'' (2) ''be honest in whatever negotiations preceded such commitments,'' and (3) ''not take excessive advantage of another even when the opportunity is available'' (Cummings and Bromiley 1996, 303). Trust is a central component of collaboration because it reduces complexity and transaction costs more quickly than other forms of organization (Chiles and McMackin 1996; Ostrom 1998; Smith 1995)" (Thomson et al., 2007, p. 28). ***Norms of reciprocity*** can be thought of as partners demonstrating "a willingness to interact collaboratively only if other partners demonstrate the same willingness. This 'I will if you will' mentality (tit-for-tat reciprocity) is based on the perceived degree of obligation, such that partners are willing to bear initial disproportional costs because they expect their partners will equalize the distribution of costs and benefits over time out of a sense of duty" (Thomson & Perry, 2006, p. 27). The shift from contingency (i.e., relationships based on obligation or reciprocity) to commitments (i.e., relationships based on shared commitment or trust) is what the norms process dimension of IOC theory addresses.

Participants in my study echo many of these ideas about obligation, reciprocal exchange-based relationship development, anchoring relationships on a shared commitment, and building trust between partners. Table 8 provides an overview of the concepts that were thematically derived from my data analysis along with abstracts that describe what the concepts convey from

the dataset as related to the 'norms of trust and reciprocity' process dimension and my interpretation of participants' storytelling.

Table 8. Results Summary for the 'Norms' Process Dimension

	Concept	Description
Norms of Trust and Reciprocity	Behaviors that Build Trust	Partners' efforts to demonstrate transparency, dependability, and alignment on mutual interests, creating conditions for trust development.
	Building Trust through Repeat Performances	Partners' efforts to deliver consistent, observable outcomes across successive interactions and uphold commitments over time.
	Maintaining Relationships through Continuity	Partners' efforts to sustain regular, predictable engagement, honor commitments, and demonstrate willingness to exceed minimal obligations.
	Maintaining Relationships through In-Person Engagement	Partners' efforts to prioritize face-to-face interaction, site visits, and shared events that create interpersonal bonds and signal commitment.

These concepts, presented as findings in my study in the discussions that follow, provide coverage across the 'norms of trust' and 'norms of reciprocity' aspects of the process dimension as described by Thomson and Perry (2006), although the latter aspect to a lesser degree because of limited data. Coincidentally, the 'reciprocity' dimension also lacked sufficient evidence in Thomson and colleagues' (2007) validation study: "We found little support for the indicators of reciprocity" (p. 42). Recall that prior studies on cross-sector partnerships (CSPs) in engineering education found that the most cited social capital resource is trust (Awasthy et al., 2020; Campbell, 2017; Eddy, 2010; Kunttu, 2017; Morell, 2014; Thune, 2007, 2010; Tucker et al., 2024), demonstrating that the emphasis on trust over the emphasis on reciprocity in my dataset is also consistent with existing literature. Alignments between my findings and IOC theory are discussed in chapter five. My interpretation of participants' experiences as they relate to each of the thematically organized concepts in Table 8 provides the following insights into the 'norms of trust and reciprocity' process dimension within CSPs in engineering education.

Behaviors that Build Trust. When I asked participants to describe their experiences, both the ones that they deemed successful and the ones they deemed less successful (i.e., the dyad approach to the interview protocol as shown in Appendix A and discussed in chapter three), I was surprised to find that nearly all participants held strong opinions on the topic of trust. Several participants talked about the behaviors exhibited by their partners or behaviors they valued as enabling (or hindering) trustworthiness between partners. My findings cover a range of ideas both echoed by prior studies and contributing new insight to the field of study on CSPs in engineering education. Overlapping earlier discussions on developing situational awareness in the governance section, a few participants offered their perspective on how these behaviors support trust development:

> "Just making sure that everybody is aware of the relationships and the motivations and the sensitivities I think is really key to building that trust." – Kyler
>
> "The more effective any program is, or the more time sensitive it is, the more critical trust is from, you know, like there's almost a universal issue when it comes to universities. And that stems with the STEM population… (having) foreign nationals working a project… that is the number one greatest problem I've seen as far as the trust goes." – Caleb

These participants, both representing government organizations, aligned their ideas about trust with their partner's recognition of 'sensitivities' within the partnership exchanges. Kyler talked about these behaviors in terms of awareness (i.e., university partners should recognize what is sensitive, such as information sharing), and Caleb talks about these behaviors in terms of confidentiality (i.e., sharing of information poses certain risks in different situations such as partnerships involving non-U.S. persons). This finding, in my interpretation, provides additional

support for how developing situational awareness is critical for establishing governance in partnerships.

Recall from the literature review that communication is often cited as key to trust in partnerships (Eddy, 2010; Morell, 2014; Rampersad, 2015; Safrit, 2014; Schaefer, 2022; Thune, 2010). Schaefer (2022) more pointedly suggests that transparency in communication is most important. A few participants in my study corroborate this claim:

> "What made (the partnership) successful is I was honest, transparent, and trustworthy from day one of discussion. I did not beat around the bush with them, in regard to budget for example." – Denver
>
> "It's okay to fail. It's okay to not know what to do and to like communicate it, because that's the other thing, like, everyone makes mistakes. But is there a trust that you can say to the person that you're working with, 'hey, I'm trying to do this, and I don't know how to do it'… there's like a vulnerability in admitting you don't know how to do something in any of these interpersonal situations. That I think is, trust is a good concept to capture that thing." – Haven

To Haven's point, transparency means not just articulating what you know but also what you do not know. This may be a powerful idea to anchor on, for some audiences, when thinking about building trust through communication in these partnership situations. Another participant offered their thoughts on communication:

> "If somebody is responsive, you know, I don't have to send three or four emails to get a response back. So, one of the keys for trust is responsiveness. So, I always respond very quickly anytime I send an email down, either it's to (faculty) or to the (students). I get a

reply back very quickly. So, that is one of the enablers is making sure that you're communicating and responding quickly when issues come up." – Byron

In my interpretation, what Byron suggested is that building trust through communication means valuing the time and effort a partner makes in sending communications by responding within a reasonable time. Many professionals may experience challenges with responding to single communications when they have an overflowing email inbox, and so my finding points out that, when intentionally building trust with partners, prioritizing those responses may best serve the recipients' interests. Responding in a timely manner demonstrates respect and commitment to the partner (Morell, 2014).

Findings presented earlier on mutual awareness and communication that deal with behaviors for building trust were supported by multiple participants' storytelling. There were several additional insights offered by other participants, although with less consensus. For example, one participant talked about how reliability is a cornerstone for building trust:

"Reciprocity, for me, is always my foundation for trust. If you say I can hold you accountable. If you say you're going to do exactly what you're going to do or let me know 'I couldn't get to this, I'm so sorry,' then I know I can trust you with the information. Like, I know that you are reliable for me. Trust and reliability. They kind of go hand in hand." – Violet

What Violet suggested is supported by Morell's (2014) finding that reliability is often associated with trust development in partnerships. Another participant offered their perspective on behaviors that build trust:

"We're trying to get over the change. We're trying to get over 'hey, you've been doing this for a long time. I know you have the resources. You haven't changed it since, you

know, 1990. It's the same thing. It's the same book you've been using. Same content.' So that the conversation we have to have is really building trust at the beginning." – Aarav

In my interpretation, what Aarav suggested in this part of our conversation is that addressing misconceptions or setting them aside, or otherwise not allowing them to create barriers in relationships, is a behavior that supports building trust. Another participant offered a different perspective:

> "To me, that's where it begins (trust). I look at all the other stuff as you wrap it around afterwards… I establish it by mutual interest in areas… find the best partners. And those best partnerships come from trust… (people) that are passionate about solving the problem." – Kevin

Kevin suggested that trust is foundational and built on common values, an insight that shares similar qualities to earlier discussions on recognizing value frameworks when establishing governance. Commonality in mission or values is cited as enabling relationship development in partnerships (Campbell, 2017). Assuming that values are reflected through behaviors, this becomes an important insight into building trust. Often, building trust through behaviors happens over time and through repeat performances, as trust is less likely to be as evident in the earliest phases of partnerships (Kunttu, 2017).

Building Trust through Repeat Performances. Recall from the literature review that building trust often happens through repeated interactions such as forming new partnerships or undertaking new partnership activities by building on existing relationships (Schaefer, 2022; Sjöö & Hellström, 2019). One participant offered their thoughts on repeated interactions:

> "What really matters is if that person you're talking to, you have a history with, and you trust as selection of character. Oftentimes (that) will lead to, I'll say, accelerated success." – Micah

Related studies place less emphasis on the idea of developing trust over time, more often focusing on the antecedents to trust development like compromise (Eddy, 2010), honesty (Morell, 2014), and respect (Tucker et al., 2024). My findings extend the knowledge base by providing insight into how social capital resources, like trust, are longitudinally developed. To bring the idea of repeat-performances into perspective, one participant offered their thoughts:

> "In a way, the more I'm with them, the more I trust them, right, because we both carry out our end of the bargain. You know, of a partnership on a year over year over year basis. So, you build the trust over time, and the quantity of interactions and projects helps that sort of build on itself. Brick by brick." – Josiah

This 'brick by brick' thinking, as suggested by Josiah, informs us how we can conceptualize trust development over time in these partnership situations. The analogy of bricklaying is appropriate for my finding that relationship development, including trust, happens over time, incrementally, and builds a foundation for the partnership. Building trust also happens through repeated interactions where challenges are overcome, as another participant suggested:

> "It was building trust along the way… (by) overcoming obstacles and misconceptions." – Aarav

In my interpretation, what Aarav suggested is that trust was less evident in the early phases of his partnership experience, but as the partners worked through challenges together, trust developed. Other participants suggested that building trust is enabled by demonstration:

"I guess that (trust) developed over time. If you told me you were going to do something, or I could expect something, would you actually do it. Would I actually see what you said I was gonna see, and vice versa." – Doug

"I view trust as doing what you say you're going to do, essentially. And I'll be honest, that was something I was a little bit nervous about with this project because it was a new relationship that we hadn't had before… So, I will say for this, trust was something that developed along the way." – Mila

"Initially, no, they're not open to it (new partnership activity). But we showcase it and we practice it and then they start opening up to it… building trust takes time." – Aarav

These participants pointed to trust development as taking place after demonstrating trustworthiness. Each of their perspectives differs in how this demonstration can be accomplished, but the message is the same—repeat performances enable relationships to grow and mature where trust becomes more evident as initial outcomes are realized. Other participants made similar points:

"Every once in a while through that you will find people that you really trust and it's after you see them working in the system." – Kevin

"What that (reliability) does is, and that recurrence is it builds a lot of trust between the faculty and (us) because they know that they can rely on those funds arriving if they just continue to focus their students on doing better projects." – Sonny

"The first one with (faculty who) introduced us, and you know, we were kind of sort of feeling our way through it. You know, once we got to know her better and she knew us better. Just that second one just really fired." – Kyler

Each of these participants' perspectives, like the ones before, support my finding that repeat performances enables trust development. There is an overlap between these insights and those in the discussions that follow on maintaining partnerships through continuity, another time-phased idea where the ability of a partnership to continue operating requires regular and intentional maintenance.

Maintaining Relationships through Continuity. Thune (2010) suggests that having past relationships supports future continuity of partnerships and strengthens individual relationships. Although partnership sustainability was not covered in-depth in the literature review, because of limited research, sustainability is closely related to maintenance in that sustaining relationships often implies continuity. Participants in my study offered perspective on how continuity showed up in their experiences:

> "My goal coming into this (role) was to not disrupt that. I did not want to bruise any kind of relationships that had been well developed and formed at this point." – Violet
>
> "They know they can rely on that because we have these long-standing relationships and we're not gonna do anything to jeopardize that, cause, ultimately, you know, if you have a solid relationship with faculty members, they know they can trust not just the office, but you personally." – Sonny

Both Violet and Sonny talked about protecting existing relationships because they understood the value of relationship continuity in their partnerships. One participant eloquently described this idea:

> "I think doing the right thing but also doing what you can to help your end goals and make it more like longevity in the relationship, because once you have established longevity, relationships are sticky." – Caleb

This ‘stickiness’ of partnerships is what maintenance and sustainability are intended to create, enabling future partnership activity to have a more developed foundation like discussed earlier on how building trust requires a solid foundation (recall the ‘bricklaying’ analogy). One participant suggested that continuity may be even more important than developing trust:

> “In any relationship, trust is important, but I think the biggest thing is prioritizing the continuity of the relationship.” – Ramon

What it means to maintain relationships through continuity has yet to be explicitly discussed. Other participants offered insight to introduce this topic:

> “We have to constantly stay engaged to have a meaningful working relationship with them.” – Joey
>
> “One warning sign which would be obvious, is communication starts to become inconsistent… When someone has been communicative, right, and then all of the sudden it’s starting to take days, weeks, maybe a month for somebody to get back to you. That’s a problem in any context.” – Denver

In my interpretation, what Joey suggested was that intentionally engaging, regularly, with partners enables relationship continuity. We can also think of maintaining relationships through continuity like building commitment to the relationships (Kunttu, 2017), where stakeholders feel increasingly invested in the partnership over time through repeat performances like discussed earlier. There are overlaps in this line of thinking with reciprocity where, as commitment increases, the willingness of partners to go ‘above and beyond’ for their partners also increases, as one participant suggested:

> “In this particular partnership, both (parties) are very much willing to do beyond what’s expected. I’m thinking particularly of a project two years ago… where the project hit the

> end of fall semester and it was obvious it was not going to be successful… ultimately (the faculty administrator) took over advising of the project, and added that to her workload, we all worked over the semester break to get the team where they needed to be at the start of the spring semester." – Carla

Carla provided an example of a time when her university counterpart (a faculty administrator of a capstone program) went 'above and beyond' their normal duties to ensure that Carla's goals were met through the partnership activity. This willingness, or commitment to the continuity of a partnership, is what my finding speaks to—maintaining relationships to the benefit of future partnership interests. There are other ways that participants in my study talked about maintaining relationships as well, such as in-person interactions which may strengthen the interpersonal connections between individuals within partnerships.

Maintaining Relationships through In-Person Engagement. A 'norms of trust and reciprocity' topic that is not well covered by existing studies of CSPs in engineering education, but was well covered by my dataset, is how partnerships are maintained through in-person engagement. Earlier I talked about how the commitment of partners to the relationship may increase through continuity, and how trust develops over time through repeat performances. One participants' narrative helped to connect these ideas to the value of in-person interaction:

> "My personal opinion is you just can't replace getting out and visiting. Be there frequently. Often, it demonstrates that you care, and it demonstrates the importance of the work. Shows commitment." – Sonny

What Sonny described was how in-person visits to their university partner sites supported interpersonal relationship development and demonstrated commitment to their partner. Another participant offered insight into how interpersonal relationships can be developed in this way:

"It's important, and a lot of people don't get it, and that is you have to show up and see them in person. So, you can do everything through Zoom and Teams, or Google Meet, or whatever, but if you show up for the kickoff, or for the final, or somewhere in the middle, right, and meet people in person, that really helps establish this bond, or whatever you want to call it, between you and the other people, professors, deans, students, etc. So, you can phone it in, but it's not going to serve you as well if you show up." – Josiah

Josiah recognized that although most (if not all) aspects of his partnership activities could be addressed through virtual modalities, they may not offer the same type of value as in-person engagement. He continued:

"That face-to-face interaction… That helps you with your trust building. If you have a school where you do one or two projects a year and you never actually meet them in person, right, it's all done remotely. There's less of a relationship there." – Josiah

Josiah doubled down on his claim that in-person engagement directly supports relationship development and building trust between partners. Sonny shared a similar sentiment:

"You have got to get out and visit sites, like, they're our relationships, not just with the schoolhouses, but also even with (us). One of my requirements as a director is… I mandate that all of us visit (university partners) at least once a month… those interpersonal physical interactions are irreplaceable via Teams, you know, and the visits that we do four times a year with each of the schoolhouses are essential as well because… that's not going to have the same effect as having them (students) all in one room where they're all, you know, they can't have their phones out. You know, they can't be doing something else. They can't put me on mute. You know, you physically have to go there and stand up in front of these people and communicate why you're there,

> why you've taken the time to visit them. And why it's so important to put their time and energy into a project." – Sonny

What Sonny offered was a specific example of how in-person interaction creates a different type of atmosphere in his engagement with students—one where they may be more attentive to his presence and the interaction. Another participant echoed this point:

> "It really does help the lines of communication and especially when you put the effort in to go do a face-to-face. It just helps facilitate the conversation and keeps things moving along." – Joey

Each of these narratives from my study participants provides insight into the finding that maintaining relationships through in-person engagement supports the overall partnership success and sustainability, providing new knowledge to the research community who study CSPs in engineering education. Collectively, my findings for the 'norms of trust and reciprocity' process dimension provide insight into how external partners of engineering education describe the value of building trust through behaviors, over time and through repeat performances, maintaining relationships through continuity and in-person engagement, and in support of future partnership opportunity.

4.2.6 Summary of Findings

The second research question asked how external partners of universities describe collaboration processes through their experiences. My results provide a detailed answer to that question, organized by the *Five Dimensions of Collaboration* as proposed by Thomson and Perry (2006), through how participants described their partnership experiences. ***Establishing governance***, according to my study participants and through my interpretation of their storytelling, involves developing situational awareness (i.e., understanding partner's situations

beyond what may appear to be directly relevant to the partnership), recognizing value frameworks (i.e., understanding the type of benefits partners seek, which may not always align with what is stated in initial communications), building inter-organizational chemistry (i.e., a willingness to be open to new ways of collaborating or new opportunities for partnership activity), communicating expectations (i.e., discovering partner's expectations, which may not always be evident in early discussions and may evolve over time), and describing how the role of champions supports these efforts (i.e., how individual intermediaries support all aspects of establishing working rules, negotiating on behalf of their employer and advocating on behalf of their partner). Each of these findings has some degree of literary support but also contributes to literature in unique ways.

Prior studies offer insight into how cultural differences pose challenges to partnerships (e.g., Eddy, 2010; Morell, 2014), and my findings provide additional insight into how recognizing cultural differences as part of establishing governance can help to address those challenges. Similarly, prior studies offer insight into how differing needs and expectations pose challenges to partnerships (e.g., Perkmann et al., 2013), and my findings provide insight into how communications can be structured to ensure clarity in expectations. Although relationship development is core to research on cross-sector partnerships (Kezar, 2005; Thune, 2010), my findings provide specific insight into how building what I call 'inter-organizational chemistry' through openness and a willingness to try new things, and learning from one another throughout a partnership, supports relationship development. The role of the champion was discussed in the literature review with insights such as how their boundary-spanning capacities support partnerships (e.g., Edmondson et al., 2012). My findings provide specific insight into how these capacities show up in the situation of cross-sector partnerships in engineering education towards

establishing governance, such as how champions both translate their employers' goals and advocate internally on behalf of their university partner. These insights are specific to what takes place early on in a partnership and preceding the implementation or execution of partnership activities as distinguished by the administration process dimension.

Administering partnerships, as understood in my study, involves implementing partnership interfaces (i.e., structures and mechanisms that enable partnership activity, including how individual interfaces can pose risks to partnerships), the involvement of executives and other senior leaders in partnerships (i.e., how partnership administration can be enabled, or hindered, by their support and involvement), and addressing day-to-day operational challenges (i.e., ensuring contractual agreements are installed when necessary, information protection is handled appropriately, and administrative hurdles like transferring funds are dealt with). Prior research provides insight into multi-level organizational structures often needed to administer partnerships (e.g., Morell, 2014; Thune, 2010). My findings provide additional evidence to support these needs and include specific insight into how this is handled on the external partner's organization side such as who approves funds, who handles funds, and who is responsible for funds allocated to university activity being used for their approved purposes. Executive and senior leadership support and involvement in partnerships is often recommended in existing research (Safrit, 2014; Eddy, 2010). My findings corroborate some of these insights but also address how some approaches to leadership involvement can pose challenges to partnerships or create bottlenecks in decision-making. Although prior studies that deal with the research-partnership situation with universities provide insight into operational challenges, little work has been done on the education-partnership situation. My findings provide needed insights into how administrative procedures, such as accounting and scheduling, can pose challenges to cross-

sector partnerships in engineering education. These insights are specific to the implementation of partnerships, and my findings indicate that certain challenges, as described by participants in my study, can create tensions between organizations in partnerships.

Organizational autonomy is defined as the tension between organizational self-interests and the collective interest of a partnership (Thomson et al., 2007). My findings, aligned to this process dimension, include the tension between desired student learning outcomes and the tangible benefits sought by external partners (i.e., some situations require external partners to make concessions in their desired benefits assumed by the outputs of student-related activity, like capstone projects, because of the university partner's or program's needs or requirements for student learning), and how university-internal autonomy can create tension in partnerships (i.e., participants describe how variation between institutions and within institutions on how partnerships are handled creates certain challenges). Ownership of intellectual property generated through partnership activity is core to many research partnership-focused studies (e.g., Perkmann et al., 2013), and little prior work has been done on this topic for the education partnership situation. My findings provide insight into how external partners of engineering education describe their expectations in terms of these rights and how these types of issues can impact partnerships (e.g., one participant cited not working with certain institutions because of issues related to intellectual property rights). My findings also provide insight into the tension between what external partners seek to gain through education partnerships and the constraints of university programs, specific to project-based learning activities like capstone design experiences. Existing research on capstone design in engineering offers a wealth of knowledge on how these experiences prepare students for work through experiential learning (e.g., Deters et al., 2020; Paretti et al., 2019; Ford et al., 2019), and my findings provide additional insight into

how this learning-focus of the university translates from the external partner's perspective. My findings also capture the frustration expressed by several participants related to variation in how these design experiences are run (e.g., partner involvement in activities and expected benefits from project outputs) within and across institutions. How these tensions are addressed was explored in my findings related to the mutuality process dimension.

Mutuality is defined as the process of 'forging mutually beneficial relationships' (Thomson & Perry, 2006) through interdependency, accommodation, and common appreciation or passion for issues between partners in an inter-organizational arrangement. My findings aligned to this process dimension include behaviors enabling accommodation (i.e., creating opportunities for goodwill relationships to be formed between partners through accommodation and the efforts of intermediaries to bridge language and build community) and anchoring partnerships on shared foundations (i.e., addressing conflicting interests between partners by orienting partnerships through shared interests and values, specifically the emphasis on student learning as the highest priority in some partnership situations). Prior studies describe how partnership intermediaries (i.e., champions) transcend functional boundaries between organizations to develop relationships at various levels of interaction (e.g., Adams & Lanford, 2021; Sjöö & Hellström, 2019; Veles et al., 2020), acting as translators between organizations (Edmondson et al., 2012). My findings provide specific insight into how external partners perceive these champion behaviors and the value it creates for partnerships such as community development (or 'synthesis' as one participant suggested). How developing a shared vision, purpose, and goals supports partnerships has been well described by existing literature (e.g., Campbell, 2017; Eddy, 2010; Edmondson et al., 2012; Morell, 2014; Vuoriainen et al., 2024). My findings provide specific insight into how these shared interests can become an anchor for

cross-sector partnerships in engineering education, such as mutual interest in solving complex, systemic problems like workforce development and the mutual investment of partners in supporting student learning above all other self-interest goals. Mutuality is a social capital resource in partnerships (Safrit, 2014) alongside other resources like compromise (Eddy, 2010), reliability (Morell, 2014), transparency (Tucker et al., 2024), and trust (Thune, 2010). These social capital resources beyond mutuality, including those captured within the 'norms of trust and reciprocity' process dimension as described by Thomson and Perry (2006), were explored in my study separately.

Norms of trust and reciprocity in IOC theory addresses how partnerships can shift from contingency-based (or obligation) to commitment-based relationships. 'Norms of reciprocity' is about the 'I will if you will' mentality (i.e., a partners willingness to bear disproportional costs and benefits because of the expectation for costs and benefits to equalize over time) and 'norms of trust' is about making good-faith efforts, relying on mutual commitment and not taking 'excessive advantage' of the other partner if given the opportunity (Thomson et al., 2007). My findings bridge these two types of norms and include demonstrating behaviors that build trust (i.e., the actions and understandings of each party that enable, or hinder, trust development), building trust through repeat performances (i.e., trust development happens because of prior success and demonstration of trustworthiness), maintaining relationships through continuity (i.e., relationships require intentional maintenance over time to sustain), and maintaining relationships through in-person engagement (i.e., the specific idea that in-person interaction supports relationship development, such as building trust and creating opportunities for reciprocal behaviors, better than other forms of interaction). Each of these findings has some degree of literary support but also contributes to literature in unique ways.

Prior studies of cross-sector partnerships in engineering education found that the most cited social capital resource is trust (Awasthy et al., 2020; Campbell, 2017; Kunttu, 2017; Tucker et al., 2024). Several studies suggest that communication is key to trust in partnerships (Eddy, 2010; Rampersad, 2015; Thune, 2010), and my findings provide specific insight into how communication between individuals in partnerships supports trust development (e.g., one participant talked about responsiveness being an enabler of trust development). Other trustworthy behaviors my findings provide insight into include transparency (e.g., one participant described how honesty, even when unfavorable, enables trust development) and reliability (e.g., one participant described how 'doing what you say you're going to do' enables trust development). The recognition that trust development happens over time and through repeat interactions is addressed by existing research (e.g., Schaefer, 2022; Sjöö & Hellström, 2019), and my findings take this a step further by suggesting that repeat performances (i.e., not just repeat interactions but demonstrations) are important for building trust between partners (e.g., recall Josiah's 'brick by brick' statement). The concept of relationship continuity for sustaining partnerships is also covered by prior studies (e.g., Thune, 2010), and my findings provide specific insight into how external partners perceive relationship continuity as a way of maintaining relationships, building trust, and enabling opportunities for reciprocal exchanges. My finding that in-person engagement supports relationship maintenance is not well covered by existing studies of cross-sector partnership in engineering education. The related insights include how participants described face-to-face interaction as enabling trust development, facilitating interpersonal relationship development, and demonstrating commitment to partnerships.

These topics and internal discussions collectively, supported by my dataset and generated through my own interpretative perspective, address the second research question and offer

specific insights that extend existing literary findings and create new knowledge addressing process dimensions of cross-sector partnerships in engineering education. The takeaways from my findings to this research question and the former research question on antecedents to partnerships are presented in chapter five. Overlaps in my findings for each of these questions were discussed throughout the results and evidenced by the dataset. The third research question, addressed in the subsequent discussion, considers variation across organizational sectors (i.e., differences between organizational types as described in chapter three) in terms of my findings regarding the first two research questions.

4.3 Research Question 3: Variation Across Sectors

My findings addressing the first two research questions provided insight into partnership antecedents and collaboration processes that transcended the types of organizations outside of academia that partner with universities on engineering education. In this section, I address the third research question: **(RQ3) How do the perspectives of external partners vary across sectors?** My analysis revealed variation in perspectives of participants who represented for-profit organizations (e.g., private for-profit organizations, including private defense contractors) and those who represented government-affiliated organizations. These distinctions in participant perspectives align with how existing literature often differentiates sectors (e.g., sectors classified as government, industry, or academia) (e.g., Etzkowitz, 2003; Perkmann & Walsh, 2007), although I also present additional distinctions evident in my dataset that are less described in existing literature (e.g., private, non-profit organizations, often included within the 'industry' sector, are distinguished from private, for-profit organizations). Table 9 shows each of the groupings, by type of organization, that I used to develop findings that address the third research question.

Table 9. Organization-Type Groupings Used for Findings Related to Cross-Sector Variation

Organization-Type Group	Abbreviation	Number of Participants
For-Profit Organizations (all private, for-profit organizations, including defense contractors)	FPO	12
Public, Government-Affiliated Organizations (exclusively)	GOV	6
Private, For-Profit Defense Contractors (exclusively)	DC	4
Private, Non-Profit Organizations (exclusively)	PNP	2

I did not include 'private, for-profit, non-defense contractors' in Table 9 as shown in my study sample (see Table 1)—I found little to no variations in the dataset that distinguished these types of organizations from others. However, I did find that 'private, for-profit, defense contractor' types of organizations presented with distinct variations, thus leading to my inclusion in Table 9. I also included private, non-profit organizations as a separate grouping in Table 9 because my analysis revealed distinct variations for those types of organizations as well.

Prior studies of CSPs in engineering education offer little insight into how perceptions of partnerships with universities vary by the types of organizations (i.e., the external partners). My findings do not offer contrasting insights between distinct groups (e.g., FPO versus GOV) but rather insights emphasized by certain groups more than others. My findings are summarized in Table 10.

Table 10. Results Summary for Cross-Sector Variation

	Topic	Sub-Topic
Cross-Sector Variation	Variation Across Sectors	Differing Cultural Norms
		Assumptions about Academia
		The Role of Partnership Champions
		Differing Perceptions of Value
		Influencing Students' Career Choices
	Macro-Scale Perspectives	Strategic Partnerships
		Ecosystem Development

The topics and sub-topics shown in Table 10 do not reflect any strategic presentation of findings other than my own decisions on how data should be presented in a systematic and digestible manner for a reader. This decision is consistent with a topic-summary approach to the presentation of study findings (Braun & Clarke, 2022).

4.3.1 Variation Across Sectors

Organizations commonly associated with different sectors (e.g., government, private industry, and academia) typically have distinct cultures because of differing missions (Eddy, 2010; Gillen et al., 2021; Morell, 2014; Safrit, 2014). Academia is often focused on graduating students and publishing research (Morell, 2014), private industry on selling products and services (Morell, 2014), and government organizations on serving public interests (Feller et al., 2005). Government organizations exist at various levels (e.g., local/regional government, state government, federal government) and participants who represent government organizations in my study aligned primarily with the federal government (i.e., public organizations managed by the U.S. federal government). For CSPs in engineering education, my findings reveal that organizations representing different sectors perceive partnerships in different ways. My findings, aligned to these differing perceptions of partnerships, include differing cultural norms (e.g., language and values), differing roles of partnership intermediaries (i.e., individual partnership

champions), differing perceptions of value generated through partnerships (e.g., commercialization opportunity for student project outputs), and differing strategies for influencing students' career choices through partnerships (e.g., promoting government careers rather than promoting a specific organization as a potential employer). My use of the term 'differing' is not intended to imply contrast in my findings for distinct types of organizations. Although certain types of organizations more often place emphasis on a particular insight, my dataset does not support the claim that any insight is entirely unique to those types of organizations.

Differing Cultural Norms. The institutional goals of government, private industry, and academia are fundamentally different (Schaefer, 2022). These terms—government, industry, and academia (or university)—are commonly used to distinguish sectors from a macro-level perspective (e.g., Etzkowitz, 2003, uses these terms in his foundational work on the 'triple helix model of innovation' theory of cross-sector partnerships). These distinctions were supported by how participants in my study described cultural norms of different sectors. For example, one participant who represented a for-profit organization (FPO) described a cultural norm of private industry:

> "A lot of times, the trouble comes when people (internally) come to a capstone experience, expecting it to be sort of like contract work… like the work order of what we're expecting. And that's been the negative, like the archetype transaction we're expecting… 'We're paying you for this expectation or output. We don't care how you do it. We're gonna have a check at the end to determine if you were able to satisfy these requirements. If not, we're gonna be upset about it.'" – Haven

Haven pointed out that his employer often approaches capstone projects at universities like any other contract work. There is an expectation that because the organization is paying money to the university, certain outputs should be provided to generate a return on their investment. In my interpretation, Haven was also suggesting that he does not share that viewpoint and that it presents challenges to his employers' university partnerships. Other participants representing FPO's made similar suggestions about the cultural norms of private industry:

> "There's a commercial issue that comes about… we want all the rights that you design and develop. The universities want some sort of royalty coming off the work that they've done. That seems to be one of the biggest headaches that we run into that tends to jam up partnerships with universities." – Dustin
>
> "Honestly, in the end we don't work with them as much as we do the other schools, or if we give them a project, it's not one where we're going to invent any IP, just because I can invent IP at (other university) and I know that I get all the rising IP, because I'm paying for it. Other schools don't do it that way, and whether they realize it or not, you know they're not getting project scope." – Josiah

These data were also presented in my response to research question two for the organizational autonomy dimension concerning organizational tensions with intellectual property ownership. My finding is not about the specific cultural norms of private industry described by participants, which in this case is how paying for student project activities at universities may be viewed similarly to other pay-for-service activities by private industry organizations, and instead indicates that FPO's may be more likely to emphasize cultural norms of private industry when describing their partnership experiences. What those norms are is not explicitly covered by my study, because of the scoping decisions discussed in chapter three, and the finding speaks to the

distinctions in how individuals representing distinct types of organizations (i.e., sectors) described their partnership experiences.

Consistent with my finding that participants who represented private industry were more likely to talk about the cultural norms of private industry, participants in my study who represented government-affiliated organizations (GOV's) were more likely to talk about the cultural norms of government. For example:

> "Some schools… they sort of separate the contractor type work, like where they're actually delivering things to the government… We just had to be careful since we advised the government that we couldn't be involved in any projects that we might find outside as the government's agent… There's been a few times, like working with (university partner) that we'd be like 'oh, hang on a second, you're actually doing that work for (another government organization), and we can't really talk about that.'" – Tyler
>
> "There's almost a universal issue when it comes to universities. And that stems with the STEM population… (having) foreign nationals working a project… that is the number one greatest problem I've seen." – Caleb

These participants described cultural norms of government in terms of the type of awareness a university partner needs to have when partnering with government-affiliated organizations. Tyler talked about how government employees can have a potential conflict-of-interest when other government organizations are doing business with their university partner. Caleb talked about a potential risk of working with universities—foreign nationals could be granted access to U.S. government information, which may not always be compliant with federal laws or policies. Another participant, who also represented a GOV, made a similar point:

> "The problem is that, if you look at a class like take nuclear engineering for example, undergraduate nuclear engineering at a school… In the entire class there might be three or four U.S. citizens. Right. The rest are all foreign nationals… That's just one of the challenges that we face in our partnerships." – Sonny

Each of these GOV-affiliated participants placed emphasis on the 'sensitivities' (a term Caleb and Kyler use in earlier quotations) of government organizations and how they can impact partnerships with universities. As I mentioned earlier when discussing the cultural norms of private industry, my findings are not about the specific cultural norms and instead indicate which types of organizations, as represented by participants in my study, were more likely to talk about distinct types of cultural norms. Private industry participants talked about private industry norms, and government participants talked about government norms—my finding illuminates that distinctions between government and private industry are evident in how participants discussed partnerships.

Participants representing private, non-profit organizations (PNP's) placed emphasis on situational awareness (recall that discussion from the governance section of my findings for research question two) in a way participants representing other types of organizations did not. For example, one participant representing a PNP provided perspective on the private, non-profit situation:

> "I just felt like their outreach was just very monetary after a while… and I understand it, like, I'm a non-profit. I get it. I'm always reaching out for people to ask for money. I get it, but it's just, as a non-profit, I just feel (that) for a university to ask a non-profit for money is a little insane." – Julie

> "Once they (university partner) saw that we were going to pay for projects, they kept saying 'oh, you know, we have this opportunity and this opportunity,' and they just keep reaching out with opportunities (to the point where) I ended up just stopping the conversations, because, as a teeny, tiny non-profit that really doesn't have a lot of funding, I need to make it very clear that we weren't sort of this new little gravy train that they were gonna be able to keep pegging for, you know, multiple years." – Julie

What Julie described was a constraint of PNP's concerning funding available to support partnership activities with universities that required payment. I've captured this finding as a 'cultural norm of private, non-profit organizations' because it provides insight into how these types of organizations approach CSPs in engineering education different than other types of organizations. Another participant who represented a PNP in my study offered another perspective on the private, non-profit situation:

> "I do think (private, for-profit) industry has a little more wiggle room of being able to repeat things or build on it (student projects) or improve, whereas, I will say it's very disheartening for (our clients) to get to the end of the year… seeing the production (of their product), thinking they're going to get something at the end. And if it's not successful, that's a lot of emotional burden that everyone shares. I mean the faculty advisor, the team, me, the (client). But it's ultimately the (client) who doesn't get what they were hoping to get to change their life in many ways." – Carla

To provide context for this part of my discussion with Carla, she represented a PNP that leveraged student engineering projects at universities to develop assistive technologies for people with disabilities (i.e., the 'clients' referred to in her statement). For Carla and her employer's situation, the output of student projects needs to provide direct benefit to a real person. Although

my study sample only included two PNP perspectives, their insights that may be transferable to other PNP situations—distinct types of constraints can impact partnerships with private, non-profit organizations than other types of organizations. Julie was also the only participant in my study to provide perspective on role expectations for student project activities:

> "Partnering with them (university partner) was a pretty heavy lift. We had contracts. I had to fly to (their location). I met their Dean. I met their entire team that was responsible for this (project). So, that was also like a pretty heavy lift in regard to what I thought this partnership was going to look like. And it wasn't really laid out to me (that) I was going to need to meet with the students weekly. I did not necessarily understand that. And they said that those students were also going to be in classes, working on this throughout the week, and my meetings with them on Friday's was specifically around building the project and any questions they had. But it definitely didn't seem like they were getting a lot of direction within the framework of their professors." – Julie
>
> "Let's make sure that there's contracts, understanding what my involvement is as a non-profit. What, exactly, is my responsibility to the university and to the students. That is definitely something that I would like to know. So, there's just not surprises… Understanding what the lift is from me as a mentor… For example, if you're expecting me to fly out multiple times within the course of a semester or the year. How this program is being run, I'd also like to understand that expectation. I think just the more information I know about the program, the better." – Julie

Julie provided insight into how she thinks about partnerships with universities as a representative of a PNP, and in a way that participants who represented other organization types did not. There weren't sufficient data to claim that PNP's are more focused on role expectations in partnerships,

and my finding is more suggestive that private, non-profit organizations may be more likely to desire clarity on role expectations, presumably because they are less likely to be compensated for their work (e.g., Julie mentioned her work for the PNP was volunteer and unpaid) and are protective of their time (e.g., Julie mentioned she works a full-time job on top of working for the PNP). Recall from the literature review that transparency and clarity in communication are critical for the success and sustainability of partnerships (Schaeffer, 2022). From this perspective, the insight Julie provided may transcend the PNP situation and offer insight into CSPs in engineering education broadly.

Although there are overlaps evident in the 'cultural norms' of these distinct types of organizations, as presented in my response to the first two research questions, there are also distinctions in the types of emphasis participants placed on certain ideas (like those presented in this section). Although all participants in my study provided insight into cultural norms of academia, there was a distinction evident to me in the data for how distinct types of organizations talked about these norms.

Assumptions about Academia. Prior research on CSPs in engineering education suggests an industry perception that academia moves too slowly in partnership processes to meet their needs (Morell, 2014; Tucker et al., 2024); industry partners also may be skeptical at times about the return on their investment (i.e., of funding and time committed) in education-related activity (Ankrah & Al-Tabbaa, 2015; Schaefer, 2022). Participants in my study that offered similar types of perspectives (or what I refer to as 'assumptions') about academia were most often representatives of FPO's. For example:

> "A very hot topic currently is around AI (artificial intelligence) sort of ruining the education model. So now everyone has access to ChatGPT (a generative AI software

> application) or LLMs (large language models) … They can create output that's able to satisfy the requirements of assignments that requires absolutely no thought… You can view it as like a wake-up call to the idea that the way we've been teaching people has been totally offset and totally wrong, and that memorization does not matter at all." – Haven

What Haven suggested, beyond the disruptive nature of recent technologies like generative AI, is that educational systems that place emphasis on rote learning may not be sufficient to adequately prepare engineering students for real-world applications. In my interpretation, the assumption implicit in this narrative is that academia is not responding quickly enough to the changing needs of industry. Recall from the problem statement that engineering colleges must continuously adapt their education programs to meet evolving workforce needs (ASEE, 2009; BHEF, 2018; Brunhaver et al., 2018; Duderstadt, 2008; Litman et al., 2023; NAE, 2005; NRC, 2007; Sheppard et al., 2008)—Haven's suggestion may be pointed directly at that need and offering a critical perspective on how well it is being addressed by current education systems. Another participant who represented an FPO provided additional perspective (assumption) about academia:

> "The thing that they (universities) are the worst at is thinking about the five plus year future. They're very good at thinking 'what I got to do this year and next year' and even the year after that. But you ask anybody, what's your plans for five years from now. They don't have any, like, 'I will get to that two years from now, you know when it's only three years away, and then we'll worry about it. I mean, it's literally that short-sighted and when they do put together a plan of what to do, they get to about five years out and they say, 'whatever that thing is, we're just going to keep doing that, like, for eternity.'" – Josiah

What Josiah suggested was that academia does not always plan changes to their education systems over long-time horizons (e.g., 'five years from now,' as Josiah suggested), or when they do, those goals can often be beyond reach and universities may be more likely to continue with historical approaches rather than follow through on making changes. Another assumption about academia is offered by Aarav, who also represented an FPO:

> "One university that we were working with, they were very adamant that the reason they are successful and why they are who they are is because they're so ingrained and theoretical. They're so ingrained and doing things by hand calculation, doing it the old school way, and I looked at my watch, and I said, 'you know, it's 2023,' and that was about the time I was working with them. And so, that conversation sometimes is a hard one that you're trying to get over—they know what they know and they're not wanting to change. They do what they do, and they think it's the right way and the best way. I think part of that is that they've not stepped out of that role for years, if not decades, of being a professor… They may do research that ties and it does cool stuff, but they haven't seen it like a day-to-day action of what an engineer does today." – Aarav

There may be several ideas to unpack from Aarav's statement relevant to this topic on assumptions about academia, but the one I focused on is connected to Haven's earlier suggestion that academia struggles with adapting their education systems in response to workforce needs. The assumption that Aarav made, in my interpretation, is that universities do not want to change because they think that what they are currently doing is already the best approach. A different type of perspective (i.e., assumption) about academia is offered by Alex:

> "Your ability to move up in the university is all about yourself. What did *you* [emphasis added] do. It's not about how you collaborate with somebody else. It's how do you get

> tenure through what you did. And so, it forces you into a silo… It doesn't matter, you know, they can talk all day about 'oh yeah, we got this collaborative environment across the campus,' but what you're going to find out is it's people that aren't necessarily in the academic positions that are doing all of that. It's people that are in other positions that are actually teaching class… and everybody else, it's about their tenure and it's about what they personally do and what they individually do, and (that is) part of their (university) culture." – Alex

In my interpretation, Alex was talking about how silos within universities are formed through reward structures that place greater value on individual performance than collective performance. This assumption about academia speaks to an earlier discussion on how various parts of a university are structured and operated in a different way than others because of their internal autonomy. Collectively, these examples support my finding that participants who represented FPO's in my study more often provided critical assumptions about academia than participants who represented other types of organizations. Participants in my study are considered 'champions' of partnership activity on behalf of their employers, per the sampling criteria discussed in chapter three and as introduced in the literature review discussion on the 'third space' of partnerships. All participants provided insight into the role of champions in partnerships, although I discovered that different types of organizations placed different types of emphasis on this role.

The Role of Partnership Champions. In my study, I refer to the 'third space' of partnerships as the intersections between organizations where, as discussed in the literature review, third-party organizations, or individuals, who may be employed by either or both original parties, serve as intermediaries of partnership activity. The role of individual intermediaries (i.e.,

partnership champions, like the participants in my study) includes continuously working across organizational boundaries to facilitate partnerships (Adams & Lanford, 2021; Sjöö & Hellström, 2019; Veles et al., 2020), translate and negotiate between partners (Edmondson et al., 2012), and mitigate tensions inherent to collaborative arrangements (MiSweet, 2021), such as those discussed in my response to question two. Participants in my study who represented FPO's placed more emphasis on the role of champions in managing the expectations of their employer than participants who represented other types of organizations. For example:

> "There's always an interest (internally) for us to do more, to hire more, to go to more places. So, I do have to curtail the expectations from some of our leaders to say let's think about this strategically… What universities, organizations and colleges make the most sense for our future workforce." – Violet
>
> "If we set up the right university relationship and then work on stuff now that isn't going to pan out for several years, but your foot's in the door. And you're working with the right people. You're gaining knowledge and logging hours… and you have to tell them (internal stakeholders) that some of these (university partnership activities, like capstone projects) won't pan out." – Josiah
>
> "The hard part sometimes is relaying appropriately the enthusiasm back to the people at your respective company. It's always going to go back to same thing. What's the ROI for us and how much is this going to cost?" – Joey

Each of these participants talked about how they manage the expectations of their employer, based on their knowledge and positionality as university partnership champions. In my interpretation, they understood their university partners' situations and the situation of their employer, sometimes requiring them to push back on their employer's goals (as Violet

suggested), help their employers understand that not every partnership situation may be the 'win' they hoped for (as Josiah suggested), and help their employer recognize how the return on their investment may be realized in different ways than what they expected (as Joey suggested).

I also discovered that participants who represented GOV's placed more emphasis on partnership champions advocating on behalf of their university partners to their employers than participants who represented other types of organizations. An overlap between these two sets of findings (i.e., FPO's emphasizing expectation management and GOV's emphasizing partner advocacy) may be Joey's statement above which alludes to both managing expectations and partner advocacy, in my interpretation. It may be worth noting that Joey represented a private, for-profit defense contractor (DC), and this overlap could speak to how DC's share similarities to GOV's with respect to the role of the champion. Concerning the emphasis on 'partner advocacy' as a role of partnership champions, participants who represented GOV's offered their ideas:

> "You definitely need buy-in (internally)… you need to convince the key and critical stakeholders that care about talent acquisition, that care about business development, community engagement, corporate social responsibility, and innovation... So, I really did convince them early on that there's opportunity (with a university partnership)." – Denver
>
> "The other (suggestion for universities) is, invite participation… Engineers love interacting with the students… That's going to benefit the students and the (company-internal) people who are working the projects. We'll then advocate to do more with the university, because they (internal employees) really enjoy it and they see a value in doing it." – Kyler

What Denver indicated is that he had to convince various stakeholders within his company that there was value to be gained from a university partnership. He advocated on behalf of his university partner for his employer to pursue new partnership activity. Kyler also provided insight into partner advocacy but from a different perspective, suggesting that by involving others within his company in university partnership activities, he would be able to advocate to increase levels of participation with the university. In my interpretation, Kyler believed that the motivations of these internal stakeholders to work with universities would increase in response to their interactions with students. A challenge with advocating for university partnership activity, as indicated by Joey earlier, is communicating the type of value (i.e., return on investment) the external partner can expect to receive through the partnership.

Differing Perceptions of Value. A recurring theme in my findings is how participants describe what I call 'business value,' or outputs of partnership activity that can impact an organization's bottom line, and how that differs from other types of value (e.g., 'mission value' as described earlier). Another research question three finding concerning variation across sectors was that participants who represented FPO's emphasized 'business value' (as I have defined it in earlier discussions) more than participants who represented other types of organizations. I also found that participants who represented GOV's emphasized 'mission value' in a different way than other types of organizations. Prior studies have found that business value-like outputs (i.e., something that can impact a business's bottom line) from student projects are desirable to industry partners (Conradie et al., 2016; Goldberg et al., 2014), although these studies do not make distinctions between what constitutes 'industry' based on the types of organizations like my study does. Participants who represented FPO's more often emphasized that 'business value' was desirable from CSPs in engineering education:

> "In a perfect world, everything has a meaningful connection to the business that has future value. You know, we can do a project that was just good for the students and fun for the mentor, but you know, we really wanted to have a quantifiable benefit you can point to and say 'yeah, that's why we did this project,' because here it is two years later and, you know, the outcome of it is in use, or it's apparent, or it led to something else. So, no projects just for the sake of doing a project for funsies." – Josiah
>
> "The challenge is finding that sweet spot of work (where) the student feels very valuable and engaged and you know the company is receiving value out of it without risking, you know, essential business outcome." – Micah

These narratives should look familiar to my findings in earlier discussions. These participants, among others who represented FPOs, indicated that they pursue partnerships with universities in the interest of generating business value, including when those partnerships involve student project activity. All participants talked about mission value (e.g., providing students with meaningful learning experiences and professional development opportunities). However, I discovered that participants who represented GOV's talked about 'mission value' in a unique way. They emphasized supporting students broadly and with less emphasis on the recruiting interest that we might expect from a FPO (referring to an earlier discussion on motivations in my response to the first research question). For example:

> "The other thing that made it successful was the students are developing skills that are highly relevant not just for (us) but in the broader industry… So, I view it as being really successful and that it gave those students some really marketable skills." – Mila

> "Part of it is, in my case, you know, a genuine motivation to help students find out what they want to do… I just want to give that same opportunity to other people, and for the (students)." – Kyler

These participants referred to their interest in supporting student learning and career opportunities, or what I call seeking 'mission value' through partnerships. This idea is not unique to my study and prior studies have found that a concept called 'corporate social responsibility,' where businesses integrate social concerns like education into their stakeholder interactions to make a positive impact, can be a motivator of organizations to partner with universities on engineering education (Ankrah & Al-Tabbaa, 2015; Gray & Purdy, 2018; Smith et al., 2018), although there is little consensus on how this manifests in specific partnership situations. An overlap that I discovered between these two types of value (i.e., business value and mission value) is evident through the storytelling of participants who represented private, for-profit defense contractors (DC's):

> "I like that motto that (affiliated organization) has because it really influences a lot of what they dedicate themselves to, 'duty, honor, country,' and the duty is getting their job done and making (themselves) as successful as possible because in essence, that's what makes the country possible. I work under that same philosophy, so we tend to be on the same page. This is a unique opportunity for (university partner), because we're a defense contractor… There's a very extreme, serious end focus on what you're trying to achieve (through partnership)." – Joey

Another participant who represented a DC indicated their interest in supporting students in a comparable way:

> "There are many other engagements that have occurred with other parts of (the university) where the willingness to collaborate is not present. There's certainly a perception of 'no, we know how to do this stuff, and we just need you to provide this piece,' and it's like okay, well… that's all you want from us, but that's really not what they need, and it doesn't help the students, and there's other ways to better integrate... You got to be willing to be open, to try to bridge across that gap so that the educational experience is meaningful for leading into what everybody's expectation is." – Alex

What Joey described was his personal interest in supporting partnerships that have an impact on a national level, something we might expect from GOV's (referring to earlier discussions on how government organizations need university partners to understand the 'sensitivities' of working with U.S. government-related information). These findings provide insight into how participants in my study, who represented organizations across different sectors, described their perceptions of value through CSPs in engineering education. A similar type of variation that I discovered deals with how participants described their interest in influencing (i.e., not just supporting) students' career choices.

Influencing Students' Career Choices. One of the most cited benefits to external partners of engineering education is access to students (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Rampersad, 2015; Schaefer, 2022; Thune, 2010; Morell, 2014; Vuoriainen et al., 2024) for the purpose of recruiting talented students into their organizations. Although the specific interest in accessing students for this purpose transcends all types of organizations in my study, I discovered variations across organization types that fall into the broader category, as I define it, of influencing students' career choices. For example, participants who represented FPO's

emphasized corporate branding (i.e., promoting their company's brand) as a strategy more than participants who represented other types of organizations:

> "Our (products) are there on (the university partners') campus, like, you can see (our products) in a building… So, sometimes it's just brand recognition of having (products) there, right, namesake things, classrooms, capstones, info sessions in a specific course, a tabling event. All of that to me from an employer end are all good things. And at first it starts with brand awareness. I think all of us (external partners of universities), that's just the first step. And then you build out from there." – Aniya

It may be relevant to note that Aniya was the only participant whose role directly aligned with recruitment (i.e., talent acquisition, a common human resources function of businesses). In my interpretation, she thinks about university partnerships differently than other participants whose roles in partnerships are only a part of their job responsibilities and not their entire role. Another participant who represented an FPO, whose role was not directly aligned with recruiting, offered a similar perspective to Aniya's on corporate branding:

> "We've been engaging in senior project work and having interns for the summer… So, we're finding our way. I'm a big believer in the university relations. Building a brand on campus and building relationships with faculty and student leadership and having internships lead to entry-level positions. I think that is one of the best ways to build a workforce." – Ramon

Ramon connected his employers' interest in 'building a brand' with the specific activities he was involved with, including capstone design experiences and internships.

Participants who represented GOV's emphasized a different type of student-career influence more than participants who represented other types of organizations. In my

interpretation, GOV's think about branding (i.e., influencing students' career choices) at a macro-level where the interest is less in recruiting students directly into their organization and more about promoting government career pathways to students. For example:

> "You've got these bright young engineering students (and get to) help them build skills and figure out where they want to go, even if it doesn't end up being at (specific government organization). One of the longer-term goals for some of these projects is to help them (students) build not just relationships with their (project customers), but also with the federal government." – Mila

> "We're not going to hire most of the people that we put in and supported in the capstone project. At least at first. But what we did was we put them on a path to be interested in this industry, to go out and work in industry, and now we're actually seeing those folks start to come back and work at (government organization) because they remember, like, 'I did a really cool project with (them) … I think I want to go back there.' So, we're sort of playing long ball with that." – Kyler

Each of these participants offered their perspectives on how they view influencing students' career choices. Notice that Kyler used the term 'industry' to describe not just private industry, but the collective field of work that his employer is part of. This use of the term 'industry' is common, often inclusive of all organization types who have common products, services, or research interests (e.g., the 'medical' industry, the 'aerospace' industry, etc.). In my study, however, I use the term 'industry' to refer to specific types of organizations (e.g., private-sector organizations).

4.3.2 Macro-Scale Perspectives

In my response to research question one, I mentioned an idea related to 'antecedents to partnership' called 'ecosystem development.' A few participants described their motivations and strategies for pursuing CSPs in engineering education in terms of developing ecosystems and I focused on participants' narrative (Kevin) in that discussion. What was unique about this idea was that 'ecosystems' are inclusive of all organization types, in my interpretation, with the purpose of advancing common interests in workforce development in the United States. Although I did not identify participants who talked explicitly about 'strategic partnerships,' several narratives were identified as providing insight into that topic. Existing research on inter-organizational relationships (i.e., the broader domain of cross-sector partnerships, as described in the literature review section on theory) often discusses partnerships in terms of a continuum that extends from transaction-based relationships between organizations to strategic partnerships between organizations (Campbell, 2017; Marinho et al., 2020; Rios, 2022). Transactional partnerships are ubiquitous to CSPs (O'Dwyer et al., 2023; Perkmann & Walsh, 2007; Prigge & Torraco, 2006), though related studies are often more focused on the research-partnership situation than the education-partnership situation. Although there are several distinctions (i.e., variations across sectors) between 'ecosystems development' and 'strategic partnerships,' as I identify in subsequent discussions, both offer macro-scale perspectives on CSPs in engineering education.

Strategic Partnerships. Strategic approaches to partnerships are less common than transactional approaches and more complex to develop and sustain (Eddy, 2010), but also more likely to drive economic growth when successful (BHEF, 2013; Rios, 2022). Strategic partnerships often imply shared decision-making (Rios, 2022), typically involve two or more

types of exchanges (e.g., recruiting, research, and education), and commonly necessitate multi-faceted relationships between organizations to support the administration of the partnership (Campbell, 2017; Eddy, 2010; Lucietto et al., 2020; Morell, 2014; Safrit, 2014; Thune, 2010), as discussed earlier in the administration section of my response to research question two. Participants in my study who represented FPO's emphasized multi-faceted relationships more than participants who represented other types of organizations. For example:

> "There's been relationships that we have going because of not just one person or one team maintaining those relationships. It takes a lot of different people. And I think not being in a silo and allowing multiple people to engage with the university… all the partners know who does what and who supports when… I think that's key, right, the more people and different people that engage (in) different ways." – Aniya
>
> "I think, from the university side, (partnerships benefit from) allowing all the different points of contact. Sometimes it's hard to organize. Industry needs to support in multiple ways, whether it's classroom focus, whether it's career fair focus. But there's so many activities at a university level that I think people get lost in all of it… I think one team can be aware of all the activities from an employer side, but one team can't do everything. That's how I approach it. We need the supports of business team members." – Aniya
>
> "If you want to grow it (university partnership), you need to have multi-faceted relationships at different levels. Whether it's professors or department chairs and the Dean's office." – Ramon

These participants talked about how partnerships they have experienced required multiple types of people within their organization to be involved with university partnerships. Another participant who represented an FPO offered a similar perspective:

> "The conceptual scheme that we use is we don't want it to be a transactional relationship. So, our idea isn't, we're coming to the table giving something and expecting something in return. So, that's the mental model we want to remove from the student engagement experience. So, what we're looking to do is we're looking to build a community." – Haven

What Haven talked about was specific to promoting partnership strategies beyond transaction-based exchanges and indicated that 'building community' was the interest. However, in other discussions (including those where I invoke Haven's perspective), this idea of community-building is typically associated with a single FPO partner and not involving competitor organizations.

Strategic partnerships are also more likely to involve executive-level support and involvement than transaction-based partnerships (Edmondson et al., 2012). Some studies suggest this type of involvement is not always appropriate for the university side since department levels may have more autonomy in certain institutional contexts (Thune, 2010). Participants in my study who represented FPO's emphasized how executive-level involvement manifested in their partnership experiences more than participants who represented other types of organizations. For example:

> "You have to have an executive who is the sponsor of the relationship… once you (do), things fall into place from there. When I say things, I mean we'll have somebody who's making sure that we have our quarterly meetings. The Deans are all there and the

different (organization) leaders are there, and they talk about what's happening what's upcoming." – Josiah

"One of the criteria is that we have a senior executive that really wants to make this relationship (work). Otherwise, the inertia of the organization will just crush the initiative." – Ramon

"Maybe because they were not an alumni, (but the executive sponsor) took a pretty hands-off role. They signed the checks. They came to campus and shook some hands. They would resolve issues. But I basically ran the activity and set the strategy." – Doug

These participants talked about executive involvement in their partnership experiences in different ways. Josiah and Ramon agreed, in my interpretation, that executive involvement was important to the success of their university partnerships. Doug provided an alternative perspective that although an executive from his organization was aligned to the university partnership, that person may have been less involved in the day-to-day operations. My findings are not about consensus around how executives are involved but instead highlight how participants who represented FPO's talked about executive support and involvement more than participants who represented other types of organizations.

Strategic approaches to partnerships are more likely to involve shared decision-making control (Gillen, 2019). Common university engagement strategies that external partners employ, such as capstones, career fairs, information sessions, and guest speaking events, typically involve less shared decision-making control. Pursuing alternative types of engagements with universities was suggested by several participants in my study as a strategy employed in their partnerships, leading to my thinking that these pursuits of novel engagements are more closely aligned with strategic approaches to partnerships. I discovered that participants who represented FPO's

emphasized these approaches more than participants who represented other types of organizations. For example:

> "Sometimes I have to say, okay, let's maybe one try something different. Just fly with me. Let's try something a little different. Sometimes they're open to it. Sometimes they're not. Or two, we can't do all of that… when you have all these things planned. So, it's curtailing it from that standpoint." – Violet
>
> "I'm not going to (the) all-majors career fair. We're going to an engineering-specific fair, targeted, or we're going to go and curate our own day on campus… Somebody like (university partner champion), right, so I know I can go to her (and say), 'we need (specific discipline) background,' and she can help curate the best day with the best audience. So, that's where I see a lot of barriers like 'hey, we have this system built up, this is the way we need to interact because we have career services'… institutions make money from career fairs, right, and we pay registration fees. So, I understand the way. It's just not always the best target, if you will, or strategy from an employer… I think for me, I can find other ways." – Aniya
>
> "We had a strategy where we were hiring (students from competition teams) … Once (students) enter the department, their sophomore year through their senior year, they're developing that kind of skill set (we want). And I think capstone is a big part of it, for sure, but a lot of students get involved in project kind of work early. Especially if you want to work on the big projects like (student competition teams). To get on those teams as a senior, you got to be involved with them earlier because it's just in such high demand and there's only so many spots." – Doug

These participants talked about the engagement strategies they employed in their partnerships with universities that were outside of well-established approaches (e.g., career fairs, capstones, etc.), requiring shared decision-making with their university counterparts to implement those strategies.

Another engagement strategy that was emphasized more by participants who represented FPO's than other types of organizations was leveraging alumni networks. Although most participants in my study talked about the value of alumni networks in supporting university partnership activities (as discussed earlier in my response to research question one), I discovered that leveraging these networks explicitly as part of external partners' engagement strategies was more emphasized by participants who represented FPO's. For example:

> "If you've got a university that has a relationship with alumni at an industrial company, tapping into that would be first and foremost." – Micah
>
> "And then also, just with the (alumni) working it (projects), you know, working with the university and staying in touch with the university that way." – Byron
>
> "We have an ambassador program that we started here at (employer), and I will send out specific events that align with their location or the university or college they attended. And usually, we get great buy-in and so they'll go and help represent the company… I want to lean into that as much as possible, so I use that network all the time, like, I'm doing a (workshop-type activity) with that group of ambassadors right now." – Violet

These participants talked about how they leveraged alumni networks in support of their university partnership strategies. Violet mentioned a formal process that her employer uses to leverage alumni relationships with universities. Existing research provides insight into how alumni relations strengthen organizational relationships (Safrit, 2014), but little prior work has

been done to develop an understanding of how these relationships manifest from the perspective of external partners. My study's findings help to fill this gap in our understanding of partnership strategies.

This discussion has exclusively focused on the FPO perspective because of what the dataset revealed to me with respect to how participants emphasized certain ideas related to 'strategic partnerships.' The next discussion and presentation of findings related to 'ecosystem development' does not offer a direct contrast to these findings on strategic partnerships. Instead, the discussion provides a different macro-scale perspective on CSPs in engineering education and one that may exist at a higher level of thinking about strategic partnerships.

Ecosystem Development. In my problem statement, I introduced the idea that the broader domain of my research is workforce development. If we think about workforce development as an ecosystem, like Edmondson and colleagues (2012) suggest, we may see the types of sector boundaries that I have been talking about in my response to research question three. For example, the 'triple helix model of innovation' theory (Etzkowitz, 2003) is about strategic integration of industry (i.e., non-government, non-academic organizations), government, and academia for the purpose of leveraging one another's strengths (e.g., government provides funding and regulation, academia provides knowledge through research, and industry develops products and services). The theory also speaks to the evolving role that academia (referred to as 'the university' in Etzkowitz's writing) plays in society—branching out from education-focused missions to research and entrepreneurship. Few existing theories offer universal insights into workforce development ecosystems. The closest may be Thomson and Perry's (2006) inter-organizational collaboration (IOC) theory, although it does not offer a higher-order perspective on partnerships involving industry, government, and academia as

Etzkowitz's (2003) triple-helix model does. My study helps to bridge the gap between these bodies of theory. IOC theory is built on the foundational work of Barbara Gray (1989) whose theory of collaboration (or rather, her efforts to build toward a theory of collaboration, acknowledging such a universal theory may not be possible) did involve all these different sectors, but not specific to workforce development or engineering education. Based on how I framed my study in the problem statement, there is a clear need for studies to support the development of theory on workforce development ecosystems—the situation for engineering education is not too dissimilar to other fields at a macro-level and similar fields (i.e., other education-related fields) would benefit from this type of theory development. In the narrative that follows, I present findings that may support the development of theory relevant to workforce development ecosystems.

In an earlier discussion on strategic partnerships, I presented the finding that participants who represented FPOs placed more emphasis on strategic approaches to CSPs in engineering education than participants who represented other types of organizations. Similarly for this discussion, I found that participants who represented GOVs in my study placed more emphasis on ecosystem development than others. A core distinction between strategic partnerships and ecosystem development, in my interpretation, is that ecosystems involve stakeholders who may be competitors. The focus is on creating open relationships established on a shared vision for a better future where all stakeholders benefit over the long term, which may not always be the case for strategic partnerships as I've defined them. A few participants in my study shared their ideas that align with this thinking:

> "At the end of the day, we need to synthesize the community and so we're very bullish on partnerships. And when I say partnerships, that means partnerships of equals to forward the solution by mutually dependent contributions." – Kevin

For a reader that recalls the last discussion from the partnership strategies section of my response to research question one, it may not come as a surprise that I lead with Kevin's perspective. Kevin offered deep insight into ecosystems development, and I explored a large portion of our conversation in that discussion. He was not the only participant who represented a GOV to provide this type of perspective:

> "It is essential, and for more reasons than I can even articulate, that industry, government, and academia are aligned and unified. And does that exist today? No. Does it exist in different silos? Possibly. But there's always gaps like with anything. But I think with these types of endeavors (referring to university strategy) there tends to be even more gaps. None of it makes sense to me, because the value and the impact added at the micro and macro level, to a human being, to the company's bottom line, to academia, to research, to society, to community engagement, to corporate social responsibility, everything benefits (from integrated approaches to partnerships). If you own a company, it benefits every single vertical in your business. If you're on the academic side working with industry, it benefits." – Denver

Although Denver's ideas, in my interpretation, shifted back and forth between what ecosystem development means and how it can manifest through partnerships, he was making a strong point like Kevin's point—integration across sectors is necessary to develop sustainable ecosystems that support workforce development at a macro-scale. Denver continued:

> "We've been working on drafting this industry membership agreement… and we've come a long way in general… The language has to be written in a way that industry can digest because they have their own requirements, and academia has to understand that and vice versa, industry has to understand that academia has requirements… Generally, I'm not talking about (this specific situation), I'm talking about the ecosystem… We've come a long way in getting all of those key and critical stakeholders to understand the other side, and getting all parties to understand that 'hey, we really want to do this, so let's get the language right.' – Denver

Denver also made the point that a shared language between parties is needed to develop ecosystems. Although these two participants' perspectives are the only ones I chose to explicitly include in this discussion, they were powerful enough to support my findings. What may be most relevant, in response to research question three, is that participants who represented organizations other than GOVs did not emphasize ecosystem development in their narratives.

4.3.3 Summary of Findings

The third research question asked how the perspectives of external partners varied across sectors. My study results provided a detailed answer to that question through how participants, who represented different sectors, described their partnership experiences, my interpretation of their storytelling, and my analysis of their narratives with a focus on the types of organizations participants represented. ***Differing cultural norms***, according to my study participants, included an emphasis from participants who represented FPOs on the cultural norms of private industry (e.g., expecting a return-on-investment for student projects), an emphasis from participants who represented GOVs on the cultural norms of government (e.g., working with government information can create constraints on partnerships), and special considerations for the PNP

situation (e.g., non-profits may have specific types of expectations for student projects and needs for communication between partners).

Prior studies suggest that cultural differences between organizations can present challenges for partnerships (Eddy, 2010; Gillen et al., 2021; Morell, 2014; Safrit, 2014). Reconciling those differences becomes, then, necessary for partnerships to be successful (Ankrah & Al-Tabbaa, 2015; Gray & Purdy, 2018; Morell, 2014). That process starts with understanding the cultural norms of partner organizations, and my findings provide insight into how participants who represented different types of organizations (i.e., sectors, as I defined them earlier) described cultural norms and how those norms may impact partnerships. What is not well covered by existing literature are perspectives outside of private, for-profit industry, such as private, non-profit organizations and government-affiliated organizations—my study provides insights into how the cultural norms of those types of organizations manifest and influence partnerships.

Participants in my study who described their critical ***assumptions about academia*** more often represented FPOs than other types of organizations. Some examples of these participants' emphases on assumptions about academia include how emerging technology trends can disrupt education system adaptability, how planning for education system changes is often near-sighted (i.e., not planning for a five-year period or longer time horizon, as one participant suggested), how disconnections between theoretical work and practical applications can create gaps in education systems, and how reward structures in universities may be more focused on individual performance than collective performance. Prior studies indicate that some industry professionals may feel academia moves too slowly to meet their needs (Morell, 2014; Tucker et al., 2024) and that they may be skeptical about their return-on-investment in education-related partnerships

(Ankrah & Al-Tabbaa, 2015; Schaefer, 2022). My findings provide additional evidence to support these ideas and offer new insights into how industry professionals (i.e., participants who represented FPOs in my study) describe other critical perspectives about academia and more often than other types of organizations in my study.

Although all participants in my study described ***the role of partnership champions*** (i.e., individual intermediaries) in partnerships, my findings indicate that participants who represented FPOs emphasized how those intermediaries manage the expectations of their employers more often than participants who represented other types of organizations. Prior studies have found that individual intermediaries often translate their partners' expectations to their employers (Edmondson et al., 2012) and mitigate tensions inherent to collaborative arrangements (MiSweet, 2021)—my findings provide additional evidence to support these ideas and offer specific insights related to the active role champions play in managing their employers' expectations for partnerships. My findings also indicate that participants who represented GOVs emphasized how partnership champions advocate on behalf of their university partners to their employers. Little prior work has been done to capture this idea of 'partner advocacy' and my findings provide new insights through my interpretation of participants' storytelling and how those insights are more emphasized by government-affiliated organizations.

Participants in my study expressed ***differing perceptions of value*** sought through CSPs in engineering education. Throughout this chapter, I have brought forward the idea that some participants describe their motivations to pursue partnerships in terms of the 'business value' they expect to gain through partnerships (i.e., the outputs of partnership activities impact the bottom line of their employers). I found that participants who represented FPOs were more likely to emphasize this type of value over other types of organizations (e.g., these participants

described the need for student project activity outputs to provide tangible benefits to their employer). Prior studies support this idea of engineering education-related partnerships providing tangible benefits as desirable to external partners (Conradie et al., 2016; Goldberg et al., 2014)—my findings provide additional evidence to support this idea. I also found that participants who represented GOVs more often emphasized their desire to create a positive impact on student learning and career opportunities (i.e., what I call seeking 'mission value' through partnerships) than participants who represented other types of organizations. Although the idea of 'corporate social responsibility,' as discussed in the literature review, has been well studied (e.g., Ankrah & Al-Tabbaa, 2015; Gray & Purdy, 2018; Smith et al., 2018) and provides relevant insight into the 'mission value' sought by organizations through partnerships, my findings provide novel insight into how this type of value manifests in CSPs in engineering education, and specifically the emphasis from government-affiliated organizations over other types of organizations in my study.

The desire of external partners of engineering education to access students for recruiting purposes is well-articulated by existing literature (e.g., Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Rampersad, 2015; Schaefer, 2022; Thune, 2010; Morell, 2014; Vuoriainen et al., 2024). How external partners desire to ***influence students' career choices***, however, can manifest in a variety of ways not well covered by prior studies. Participants in my study who represented FPOs emphasized corporate branding strategies more than participants who represented other types of organizations. For example, participants talked about brand development at universities through capstone sponsorships, information sessions, and having branded products present within universities. I also found that participants who represented GOVs more often described their desire to influence students' career choices by promoting

government career pathways than other types of organizations—the finding was about promoting careers beyond a single organization, which is often the case for FPOs as described earlier. These findings, along with others presented earlier, collectively provide insight into how different types of organizations perceive partnerships in different ways—as determined through my interpretation of participants' storytelling and my analytic process of considering the types of organizations participants represented in my dataset. I then shifted my discussion from these situation-specific types of findings to macro-scale (i.e., broader, or higher level) types of findings as related to 'variation across sectors' in my response to research question three.

Several participants in my study offered what I call 'macro-scale' perspectives on partnerships, or perspectives that extend beyond specific situations and encompass broader, systemic ideas about partnerships. I grouped these perspectives into two buckets: 1) strategic partnerships and 2) ecosystem development. Participants in my study who talked about ***strategic partnership***-related ideas were more often employees of FPOs. They described how multi-faceted relationships with universities were often required for successful implementation, a finding supported by prior work (Campbell, 2017; Eddy, 2010; Lucietto et al., 2020; Morell, 2014; Safrit, 2014; Thune, 2010). They also described how community development shifts partnership models from transaction-based exchanges to more integrated approaches to partnerships. This type of thinking is supported by prior studies that address the continuum of transactional partnerships to strategic partnerships (e.g., BHEF, 2018; Rios, 2022)—strategic partnerships often involve more integrative approaches to structuring organizational relationships (Campbell, 2017) and promote 'open' relationships (i.e., building community on shared goals and values where partners are willing to experiment with new approaches) (Morell, 2014). Participants also described how executive support and involvement can be advantageous to

strategic partnerships, an idea also supported by prior studies (Edmondson et al., 2012). The situations described by these participants often involved a single organization (e.g., the participants' employer) and one or more university partners. In my interpretation, the 'strategic' elements of those partnership situations include multi-faceted relationships and leadership involvement, less present in 'transactional' partnerships. For ecosystem development, however, 'strategy' is less about these internal structures and more about integration across sectors in a multi-party system.

Participants in my study who talked about ***ecosystem development***-related ideas were more often employees of GOVs. For example, participants described strategic and integrative approaches to connecting industry, government, and academia through a shared vision for improving workforce development. Partnership arrangements involving all these sectors have been referred to as a 'triple helix' in prior studies (Etzkowitz, 2003). Existing literature also refers to 'developing a shared vision' as a key success factor for macro-level partnerships (Edmondson et al., 2012; Morell, 2014). Like all other findings presented for the third research question, the findings I aligned to macro-scale perspectives were not specific to how strategic partnerships or ecosystems can be developed and only reveal that participants who represented FPOs more often talked about strategic partnership-related ideas, and participants who represented GOVs more often talked about ecosystem development-related ideas. I provided examples and summaries of participants' storytelling to contextualize these findings. The topics and internal discussions I present in this discussion, supported by my dataset and generated through my own interpretative perspective, address the third research question and offer specific insights that extend existing literary findings and create new knowledge addressing how different

sectors, as I've defined them, place emphasis on different aspects of partnership antecedents and collaboration processes within CSPs in engineering education.

4.4 Results Summary

Throughout this chapter, I presented findings that collectively address how organizations outside of academia describe their experiences partnering with universities on undergraduate engineering—the central research question of my study. Participants in my study described their experiences in terms of motivations to pursue partnerships (e.g., recruiting talented students in their organizations and providing students with workplace-relevant learning experiences) and strategies for pursuing partnerships (e.g., leveraging alumni networks within organizations and experimenting with low-risk approaches to partnerships). Participants also described their experiences in terms of collaboration processes, including governance (e.g., developing awareness of partners' unique situations and recognizing one another's value frameworks), administration (e.g., implementing partnership interfaces and navigating day-to-day operational challenges), organizational autonomy (e.g., dealing with the inherent tension between the objectives of external partners and the student learning objectives of university partners), mutuality (e.g., building accommodating relationships and anchoring those relationships on shared values), and norms of trust and reciprocity (e.g., building trust through repeat performances and in-person engagement). These findings applied across all types of organizations that participants in my study represented. I also presented findings that were distinct based on the types of organizations participants represented (i.e., findings that varied across sectors), including emphasis from participants who represented private, for-profit organizations (e.g., critical assumptions about academia, how partnership champions manage expectations of their employers, and how corporate branding is a strategy employed to influence

students' career choices) and from participants who represented government-affiliated organizations (e.g., how partnership champions advocate on behalf of their university partners to their employers, motivations to support student learning as an intangible benefit of partnerships, and how promoting government careers is a strategy employed to influence students' career choices). Additionally, I brought in macro-scale findings related to strategic partnerships, emphasized more by private, for-profit organizations, and related to ecosystem development, emphasized more by government-affiliated organizations. Collectively, the findings throughout this chapter provide an answer to the central research question of my study, and I situated each of these ideas within the broader literature.

Chapter 5: Conclusions

Engineering workforce development (EWD) is enhanced by collaboration between government, industry, and academia and can address gaps between the needs of the workforce and engineering graduates' skills—gaps that continue to threaten the United States' economic competitiveness (HBR, 2018; Moser, 2021) and people's livelihoods as labor markets are transformed by innovation (Brookings, 2023; WEF, 2025b). Cross-sector partnerships (CSPs) in engineering education are one way to address societal needs for EWD—creating opportunities for the mutual exchange of knowledge and resources that enhance the workforce-readiness of engineering graduates (Lucietto et al., 2020; Tembrevilla et al., 2023) and the relevancy of engineering education programs (Morell, 2014). The pursuit of CSPs is underscored by the belief that education systems that operate without external influence are less effective in achieving desired outcomes than when education systems partner with external stakeholders (Awasthy et al., 2020; BHEF, 2018; Eddy, 2010; Gray & Purdy, 2018; O'Leary et al., 2023). CSPs in engineering education provide universities with access to funding (Kunttu, 2017; Safrit, 2014; Schaefer, 2022; Tucker et al., 2024) and opportunities to advance curriculum (Ankrah & Al-Tabbaa, 2015; Lucietto & Peters, 2025; Vuoriainen et al., 2024). CSPs provide external partners of universities with access to students (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Rampersad, 2015; Schaefer, 2022) and opportunities to influence curriculum (Lamancusa et al., 2008; Morell, 2014; Thune, 2010; Vuoriainen et al., 2024). They provide students with practical, authentic learning experiences (Ankrah & Al-Tabbaa, 2015; Burns et al., 2018; Kunttu, 2017; Lamancusa et al., 2008; Lucietto & Peters, 2025; Safrit, 2014) and employment opportunities (Goldberg et al., 2014; Kunttu, 2017; Morell, 2014; Rampersad, 2015; Tucker et al., 2024; Vuoriainen et al., 2024).

Prior studies of CSPs often overlook the collaboration processes that take place within partnerships (Ankrah & Al-Tabbaa, 2015; Carbone et al., 2016; Kunttu, 2017; Perkmann et al., 2013), which are often seen as a "black box" (Wood & Gray, 1991). In other words, the inputs (i.e., antecedents) and outputs (i.e., outcomes) of partnerships are better understood than what takes place in the process of establishing and implementing partnerships (Thomson & Perry, 2006). There is a general lack of theory in partnership studies that address process aspects of partnerships (Ankrah & Al-Tabbaa, 2015; Shah & Gillen, 2023; Thune, 2010; Tucker et al., 2024). The situation in engineering education is also challenged by partnership models that tend to be more context- and situation-dependent than those in other fields (Smith et al., 2018), such as teaching and nursing education. Given the situation of CSPs in engineering education and the need for studies to provide insight into the challenges faced in the field, the purpose of my study is to advance the understanding of CSPs in engineering education. My study addressed the following central research question aligned with this purpose: **How do organizations outside of academia describe their experiences partnering with universities on undergraduate engineering?**

My study explores the perspectives of external partners of universities (i.e., organizations outside of academia) on collaboration processes, providing insight into the complex issue of EWD. To address the process-perspectives (RQ2) in my answer to the central research question, I also explored antecedents to partnerships (i.e., RQ1, the inputs to partnerships, as described earlier) and variation in external partner perspectives (i.e., RQ3, assuming not all organizations outside of academia feel the same way about partnerships). To answer my central research question, my study addressed the following research questions:

RQ1. What antecedents to partnerships are cited by external partners?

RQ2. How do external partners characterize collaboration processes in partnerships?

RQ3. How do the perspectives of external partners vary across sectors?

To address these questions, I designed a qualitative interview study, generating data through the lived experiences of external partners of engineering education. I asked these participants questions about their partnership experiences, organized using the *Five Dimensions of Collaboration* framework proposed by Thomson and Perry (2006), and employed qualitative data analysis techniques to generate findings.

5.1 Summary of Findings

The approach to designing and conducting my study was described in chapter three—conducting interviews with individual representatives of external partners of engineering education (i.e., champion), framing questions through inter-organizational collaboration (IOC) theory, and employing qualitative data analysis techniques to develop thematic findings that addressed my research questions. My answers to the research questions are summarized in Table's 11, 12, and 13.

Table 11. Results Summary for Research Question One

RQ	Topic	Summary of Findings
RQ1: Antecedents to Partnerships	Motivation to Partner	Organizational motivations to pursue partnerships in undergraduate engineering include building talent pipelines, corporate branding, generating business value, and learning from students' different viewpoints. Individual motivations that can influence organizational partnerships include individual enthusiasm and personal passion to support student learning and career opportunities. Indirectly related to motivation, individual perspectives on 'what's best for students' include preferences for curriculum change in education programs and how experiential learning opportunities should be provided to students.
	Partnership Strategies	Strategies for deciding which universities to partner with include research commonality and geographical proximity between organizations. To form university partnerships in engineering education, strategies include leveraging alumni networks, leveraging established structures and processes, and pursuing low-risk

		approaches. External partner strategies for pursuing university partnerships also can include an (eco)systems thinking approach—multi-party ecosystems are viewed as desirable to support mutual workforce development interests between partners.

Table 12. Results Summary for Research Question Two

RQ	Topic	Summary of Findings
RQ2: Collaboration Processes	Governance	Governance is established for partnerships in the context of undergraduate engineering by developing awareness of each partners' organizational situations, recognizing each partners' value frameworks, building inter-organizational chemistry, and communicating expectations. Partnership champions often play a critical role in establishing partnership governance.
	Administration	Administering partnerships in the context of undergraduate engineering is enabled by administrative partnership interfaces and addressing day-to-day operational challenges. Senior leaders of external partner organizations often play a critical role in partnership administration.
	Organizational Autonomy	How external partners of undergraduate engineering described organizational autonomy included the tension between tangible benefits they sought and the perceived university partner emphasis on learning outcomes for students, and how differing approaches to these types of partnerships within universities can create challenges for external partners.
	Mutuality	Mutuality in partnerships in the context of undergraduate engineering is enabled by developing goodwill relationships between partners such that they are more willing to accommodate one another's goals and anchoring these partnership situations on shared foundations like common values and interests in supporting student learning and their career opportunities.
	Norms of Trust and Reciprocity	Trust and reciprocity in partnerships in the context of undergraduate engineering is enabled by each partners' demonstration of behaviors and repeat performances that build trust over time and maintaining individual and organizational relationships through partnership continuity and in-person engagement between partners.

Table 13. Results Summary for Research Question Three

RQ	Topic	Summary of Findings
RQ3: Variation Across Sectors	Variation Across Sectors	*Private, for-profit organizations* emphasize industry norms, assumptions about academia, how partnership champions manage internal expectations, the interest in receiving tangible benefits through partnerships, and corporate branding as a partnership strategy. *Government-affiliated organizations* emphasize government norms, how partnership champions advocate on behalf of their university partners to their employers, and the interest in supporting student learning as a primary outcome of partnerships. *Private, non-profit organizations* emphasize non-profit norms and how those can differ from other sectors. *Private, for-profit defense contractors'* perspectives overlap government-affiliated organizations' perspectives on the interest in supporting student learning as a primary outcome and how champions advocate on behalf of their partners.
	Macro-Scale Perspectives	*Private, for-profit organizations* emphasize how multi-faceted relationships and exchanges enable strategic partnerships, although through closed relationships where only non-competitors participate. *Government-affiliated organizations* emphasize ecosystem development as a multi-party approach to partnerships involving government, industry, and academia, including parties who may be competitors, unified by a shared vision and purpose for workforce development with perceived societal benefits.

What I present in this chapter are the conclusions that I have drawn from the study findings (i.e., what I perceived as the most important insights that address my central research question). In the subsequent discussions, I synthesize my study findings to draw conclusions about my dataset, ground conclusions in literature, and propose implications for research, practice, and policy related to CSPs in engineering education.

5.2 Key Findings

The most important takeaways from my study are that CSPs in undergraduate engineering are primarily influenced by 1) organizational value perceptions, 2) variation across sectors, 3) individual relationships, and 4) how partners leverage alumni networks. Each of these sets of insights influence organizational antecedents to partnerships and the collaboration

processes found within partnerships. These broad insights (i.e., conclusions based on findings) were generated through my reflection on the findings presented in chapter four, re-engagement with my dataset, re-engagement with existing literature, and reflection on my interpretative process as captured by my journal entries. Table 14 presents my key findings along with summaries of those findings.

Table 14. Summary of Key Findings

Key Finding	Summary
Value Perceptions Impact Partnership Choice and Process	External partners of engineering education perceive different types of value through partnerships. Those perceptions impact how they make decisions about who to partner with, how they pursue partnerships, and all five process dimensions of partnerships.
Partnerships with Different Sectors Necessitate Different Approaches	Universities are more likely to achieve desired outcomes through partnerships by tailoring their approaches to each external partner's unique situation. Every partnership situation is constrained and influenced by each partner's culture and context, goals and expectations, and other factors.
Individual Relationships Drive Collaboration Processes	Cross-sector partnerships in engineering education are driven by individuals. The relationships between individuals impact all five process dimensions of partnerships. Partnership champions play a critical role in developing and maintaining partnerships through individual relationships.
Alumni Networks are Invaluable to Partnerships	Leveraging individuals employed by organizations who are alumni of university partners can create opportunities for new partnership activities, enhance existing partnerships, and strengthen organizational relationships.

5.2.1 Value Perceptions Impact Partnership Choice and Process

External partners of engineering education perceive different types of value through partnerships. Those perceptions impact how they make decisions about who to partner with, how they pursue partnerships, and all five process dimensions of partnerships.

My findings presented in chapter four provide insight into how organizations perceive different types of benefits through partnerships with universities on engineering education. I distinguished between the benefits cited by my study participants as creating either 'business

value' or 'mission value' within their organizations. ***Business value***, as I defined it, is any benefit sought that may impact an external partner organizations' bottom line—there is a quantifiable benefit for partnering on engineering education such as commercialization opportunity from student project outputs or access to talented students for recruiting interests. ***Mission value***, as I defined it, is any benefit sought that may not have a direct impact on the external partner organizations bottom line—the benefit could be social such as supporting student learning, professional development, and career opportunities not specific to a particular organization, or the benefit could be economic such as advancing U.S. interests in economic growth through workforce development. These two types of value are discussed throughout my findings in response to all three research questions.

Business Value. My findings for research question one indicate that organizational motivations to pursue partnerships vary, impacting their decisions on which universities to form partnerships with. Some participants described their organizations' motivation to recruit students—primarily private, for-profit organizations as identified in my response to research question three. Access to students through partnerships in engineering education for the purpose of recruiting talented students is one of the most cited benefits to external partners in prior studies (Ankrah & Al-Tabbaa, 2015; Goldberg et al., 2014; Morell, 2014; Schaefer, 2022; Thune, 2010; Vuoriainen et al., 2024). Identifying which universities to form partnerships with was also discussed in my response to research question one—organizations often choose to partner with universities because of common research interests or because the types of academic programs offered by universities are related to the work of the external partner. External partners also choose university partners based on proximity—for some organizations, it is desirable to partner with institutions that are geographically close for the purpose of recruiting.

Some participants described their organizations' motivation to pursue partnerships with universities because of their intention for the outputs of partnership activity to generate quantifiable benefits to their organizations. For example, multiple participants suggested that sponsored student project activity should 'move the needle' for product or process development of their employers or otherwise create opportunities for 'future value' (i.e., there is a long-term benefit). The interest in education-partnership outputs generating this type of value for external partners is supported by existing literature (e.g., Conradie et al., 2016; Goldberg et al., 2014). The interest in generating business value through partnerships on engineering education can also create tension between the desired benefits of external partners and the emphasis on learning from university programs, as I indicated in my response to research question two. Some participants suggested that they adjust their expectations because of this tension—the original intention for student project outputs are reduced to meet the needs of their university partner or the students' capacities to generate desired outputs. Other participants suggested that they do not approach partnership situations with these types of expectations and instead their primary goal is to provide students with meaningful learning experiences—the desired benefits are more closely aligned with what I call mission value.

Mission Value. My findings for question one indicate that some organizations pursue partnerships in engineering education with the intention to support student learning, professional development, and career opportunities that are not specific to their organization. There are social or economic goals driving these organizations to partner on engineering education. Participants representing all sectors in my study indicated these types of interests, although government-affiliated organizations more often emphasized a focus on mission value over business value as influencing their motivations, strategies, and approaches to partnerships with universities.

Private, non-profit organizations, as discussed in my response to research question three, also emphasized the interest in supporting student learning over generating tangible benefits, although with the distinction that outputs of partnership activity sometimes do need to provide tangible benefits to other stakeholders (e.g., a client of the non-profit organization, like the situations described in chapter four).

Another way that I conceptualize mission value was captured in multiple discussions on ecosystem development in my responses to research questions one and three. From this perspective, the primary outcome external partners seek from partnerships is to 'raise all boats' for workforce development—findings supported primarily by government-affiliated organizations. Thinking about partnerships as part of larger ecosystems of multiple parties (e.g., government, industry, and academia) shifts the focus to addressing societal and economic challenges rather than challenges faced by independent organizations. The key finding is that these participants described ecosystems as an integrative approach by multiple parties, enhancing all parties' longer-term interests in creating efficiencies in technology innovation and workforce development. How to develop these types of systems was not evident in the data and beyond the scope of my study.

The lines between business value and mission value, as I have defined those terms, are often blurred (i.e., there are gray areas, as discussed in chapter four). Not every type of recruiting interest may be aligned to business value (e.g., promoting government careers as discussed in my response to research question one), and not every interest in providing students with real-world learning experiences are fully altruistic (e.g., some employers may perceive their influence on education as a long-term cost-savings, as described in the literature review). What is most important to take away from this collection of findings is that the value perceptions of external

partners are likely to drive their decision-making regarding with whom to partner, influence the processes involved with forming and implementing partnerships, and that there are variations evident in these perspectives along sectoral boundaries, thus necessitating different approaches by universities for partnerships with different sectors.

5.2.2 Partnerships with Different Sectors Necessitate Different Approaches

Universities are more likely to achieve desired outcomes through partnerships by tailoring their approaches to each external partner's unique situation. Every partnership situation is constrained and influenced by each partner's culture and context, goals and expectations, and other factors.

My findings in response to research question three indicate that there were variations in participant perspectives that fell along sectoral lines (e.g., private industry, government). There were also variations pointed out for specific types of organizations like private, non-profit organizations and private, for-profit defense contractors. My findings for questions one and two suggest that perspectives also vary between each independent organization—each participant in my study talked about different topics in different ways (i.e., they each indicated motivations, strategies, and process aspects of partnerships that were unique to their partnership experiences). Although in this discussion I focus on what may be most relevant to partnerships for different sectors, it is important to note that there are variations evident within each sector, and this cross-cutting finding is not applicable to every partnership situation. In this discussion, I synthesize findings across my research questions to propose considerations for partnerships unique to each sector, like my response to research question three but also incorporating findings from other parts of chapter four to propose a more holistic perspective. I also highlight potential divergences of findings within each set of considerations.

Considerations for Partnerships with Private For-Profit Organizations. I use the term "private industry" to describe private, for-profit organizations in this discussion because of how existing literature often characterizes these types of organizations (e.g., Al-Tabbaa & Ankrah, 2015; Awasthy et al., 2020; Bastos et al., 2021; Campbell, 2017; Shah & Gillen, 2023; Thune & Støren, 2015). Private industry partners of engineering education are more likely to seek business value in the outcomes of partnerships than other types of organizations. Participants in my study who represented private industry more often suggested their intentions to build talent pipelines through partnerships on engineering education. Beyond participating in traditional recruiting events like career fairs and company information sessions, private industry partners also perceive student project activities (e.g., capstone sponsorship) and extra-curricular activities (e.g., competition team sponsorship) as providing access to students for the purpose of recruiting. Through partnerships with universities, private industry organizations also seek to promote their corporate brands (i.e., the namesakes of their organizations which may include the names of products or services they sell). Providing private industry partners with opportunities to access students and promote their brand(s) are likely to incentivize their involvement in engineering education programs and activities. There are also considerations specific to the process of partnering with private industry.

The situations of private industry partners are often distinct from other types of organizations, as indicated by my findings. As profit-seeking organizations, partnerships with universities on education-related activities are likely to be aligned with private industry partners' broader university partnership strategies which often include research and recruiting components. Developing a situational awareness of private industry partners is critical to establishing governance in partnerships—recognizing what types of benefits they seek, what

their needs and goals are, and how they typically manage university relationships internally. The types of administrative interfaces required to implement partnerships with private industry organizations are also likely to be distinct from other types of organizations. Private industry often leverages executive or other senior leadership support and involvement for multi-faceted partnerships with universities to interact with senior university leadership, serve on university boards, and guide partnership activities at a high level. There are often entities within private industry organizations that handle specific administrative and operational aspects of university partnerships, like human resources for recruitment, finance for handling financial matters like the transfer of funds, and legal teams for handling agreements and contracts. This division of responsibility may be different when partnering with other types of organizations. Finally, how mutuality manifests in partnerships with private industry organizations may be contingent on their expected return on investments made through university engagement and not necessarily a product of promoting goodwill through organizational relationships, as discussed in my response to research question two.

Considerations for Partnerships with Government-Affiliated Organizations. I use the term "government" to describe public, government-affiliated organizations (i.e., government-run organizations) in this discussion because of how existing literature often characterizes these types of organizations (e.g., Ankrah & Al-Tabbaa, 2015; Cai & Etzkowitz, 2020; Campbell, 2017; Gray & Purdy, 2018). Government partners of engineering education are more likely to seek mission value in the outcomes of partnerships than other types of organizations. Participants in my study who represented government organizations more often suggested their intentions to support student learning and enhance workforce development across sectors through their partnerships on engineering education. Government influence on education and students' career

choices are more likely to be 'for the greater good' of economic prosperity (i.e., federally-run organizations seek to enhance the United States' competitiveness in fields that employ large numbers of engineers like product development and manufacturing, thereby supporting economic development). How government partners approach partnerships with universities is influenced by these pursuits—they are more likely to be direct and transparent in how they describe their needs and goals for partnerships, have administrative structures and processes like those of academia, present with less tension between their desired benefits for education activities and the goals of their university partners, and more likely to value trust and reciprocity in relationships. They may also have more constraints around how they provide resources to universities in support of education-related activity, as discussed in chapter four, a situation like that of private, non-profit organizations.

Considerations for Partnerships with Private Non-Profit Organizations. I use the term "non-profit" to describe private, non-profit organizations in this discussion because of how existing literature often characterizes these types of organizations (e.g., Safrit, 2014). Government-affiliated organizations, although technically non-profit, are not often considered as part of the non-profit category of organizations. Non-profit partners of engineering education often require different approaches to partnerships than other types of organizations. Non-profits are typically more constrained in terms of the resources they can provide universities, often staffed by volunteers or employees paid less than their for-profit counterparts, and often have distinct types of goals when partnering with universities. Developing an understanding of a non-profit partner's situation, needs, goals, and constraints is critical for establishing governance in partnerships, particularly because those factors may be different than what is common to the partnership situation (e.g., sponsoring a capstone project). Although my study sample was

limited to two representatives of non-profits, there were still several consistencies between them that I felt offered insight into the non-profit situation. Non-profits typically prefer to enter partnerships at a no-cost or low-cost negotiation, relying more on other types of resources to provide benefit to the university partner (e.g., providing service-learning project experiences to students). Non-profits are more likely to adjust their expectations or involvement to accommodate a university partner's needs and goals than other types of organizations. Although I proposed a few specific considerations for a typical non-profit, the most important consideration is that every non-profit partnership situation may be entirely unique to any other partnership situation—necessitating more time and effort to define partnerships early on and requiring close communication between individual champions of partnering organizations throughout the partnerships.

Considerations for Partnerships with Private For-Profit Defense Contractors. I used the term "defense contractor" to describe private, for-profit organizations with significant U.S. defense-aligned activity (i.e., a significant portion of the organizations' revenue is generated through contracts with the U.S. Department of Defense) in this discussion to distinguish these types of organizations from others. However, there are no fundamental differences between defense contractors and other private industry organizations. The distinction is made because defense contractors often have organizational constraints like those of government (e.g., federal standards and regulations for the design and manufacture of products, protection of sensitive information, how funds are allocated for university engagement, expectations for administrative processes, etc.). Although very little distinction between defense contractors and other private industry was discovered in my data analysis, leading to my grouping of those types together in my response to research question three, there are a few considerations for partnerships unique to

the defense contractor situation. Defense contractors may be profit-driven, but their cultural norms often share similarities to government-run organizations. For example, how participants in my study, who represented defense contractors, talked about their personal interests in supporting student learning was more like government participants than other private industry participants. They talked about 'a sense of duty and obligation' to support student learning and professional development, a finding more often aligned to government partners of engineering education as discussed in my responses to research questions one and three. How these participants described justifying resource allocation to university partners, such as funds supporting education-related activities, also shared similarities to the perspectives of participants who represented government organizations (e.g., there is often more scrutiny on how funds are used for specific purposes because they originate with government-aligned budgets).

There were overlaps and divergences within and between the sectoral lines I proposed in my findings and conclusions—not every government partner will prioritize student learning over tangible benefits (e.g., one participant indicated that all student project activity should generate new knowledge and did not suggest student learning outcomes were a high priority), and not every private industry partner seeks tangible benefits (e.g., one participant indicated their partnership activities were entirely philanthropic and part of a broader corporate social responsibility initiative of their employer) through partnerships on engineering education. These conclusions support how university partners can adjust their initial approaches to partnerships with different types of organizations and reasonable assumptions that may influence those initial approaches. However, each partnership situation will be unique and may contradict some of those assumptions, necessitating close communication between individual champions of

partnering organizations and developing individual relationships that support the organizational relationships.

5.2.3 Individual Relationships Drive Collaboration Processes

Cross-sector partnerships in engineering education are driven by individuals. The relationships between individuals impact all five process dimensions of partnerships. Partnership champions play a critical role in developing and maintaining partnerships through individual relationships.

Cross-sector partnerships in engineering education are inherently social endeavors. They are driven by people and the relationships between individuals. People are the greatest assets to partnerships, and social capital is the greatest resource within partnerships (Keast et al., 2007; Kezar, 2005; Thune, 2010). Individual relationships define the culture of partnerships (Kunttu, 2017; Safrit, 2014) and support the development of inter-organizational trust and commitment (Thune, 2010). Increasing social capital can support process simplification (Awasthy et al., 2020; Thune, 2007) and positively impact partnership success (Thune, 2010). My study findings echo these prior claims and provide new insight into how individual relationships drive collaboration processes in partnerships.

Individual Relationships Enable Partnership Governance and Administration. My findings for research question two indicate that the process of establishing governance relies on partners recognizing one another's situations and value frameworks and communicating their expectations. Differing expectations of partners is often considered one of the greatest challenges faced in partnerships (Perkmann et al., 2013). Consistent with my findings, the ability of individuals representing organizations to communicate their expectations to partners is often related to the strength of the individual relationships between partners. More plainly, individuals

who have established trust and rapport are more likely to communicate their employers' expectations transparently to arrive at a mutual understanding between partners and negotiate in good faith (i.e., individuals have a genuine intention to reach equitable agreements). The individual relationships between organizational representatives (i.e., champions) impacts the joint effort to establish partnership structures, interfaces, and administrative procedures, a finding supported by existing literature (e.g., Kunttu, 2017; Thune, 2010). As indicated by my findings, establishing governance requires understanding each partner's situation and the type of value sought through partnerships. The relationships between individual partnership champions support these processes of exchanging information and implementing administrative structures for partnerships. Several participants in my study also talked about how their interpersonal relationships with their university counterparts enabled mutuality in their partnership over time. The external partners' willingness to accommodate their university partners' needs and goals and advocate on the universities' behalf to their employer may increase as the individual relationships develop over time.

Individual Relationships Enable Organizational Mutuality and Reciprocity. My findings for research question two that addressed mutuality in partnerships indicate that demonstrating goodwill takes place at the individual intermediary (i.e., champion) level as much as it does at the organizational level. The relationships developed between individual champions can create opportunities for mutually beneficial organizational exchanges, such as collaborating on joint ventures for student project activity like the learning factory situation described by Lamancusa and colleagues (2008). Organizational values are reflected through how individuals represent their employers; as my findings indicate, there is often a preference for working with individual representatives of universities that have similar values (e.g., partnerships that

prioritize student learning above all other desired outcomes for partners, as discussed in my response to research question two concerning mutuality). My findings aligned to the 'norms of trust and reciprocity' dimension offer insight into how individual relationships enable organizational trust and reciprocity. Results indicate that through demonstrating trustworthy behaviors (e.g., individual representatives are honest and transparent in their communications with partners), organizational partners are more likely to accommodate one another's goals. Over time and repeat performances, as discussed in chapter four, trust between partners is likely to grow. These types of outcomes are enabled by the individual relationships between partners (i.e., organizational relationships evolve in parallel with and are dependent upon individual relationships).

People are the greatest assets to cross-sector partnerships in engineering education. Individual relationships create the culture of partnerships and can both enable efficiencies in process and develop organizational trust between partners. The role of the champion in partnerships was a recurring theme through my study, and my findings provide insight into how these individuals, and the relationships between these individuals, enable successful outcomes of partnerships from formation to the day-to-day operations in the implementation. Individual relationships impact all *Five Dimensions of Collaboration* as described by Thomson and Perry (2006). The importance of developing strong interpersonal relationships between the individuals who represent each partner's interests in CSPs is paramount and, based on my findings, precedes all organizational aspects of partnerships. Individual enthusiasm and passion play an important role in partnerships, as indicated in my response to research question one, and one way that partners can leverage these individual motivations is through the involvement of university alumni in partnerships.

5.2.4 Alumni Networks are Invaluable to Partnerships

Leveraging individuals employed by organizations who are alumni of university partners can create opportunities for new partnership activities, enhance existing partnerships, and strengthen organizational relationships.

A recurring theme throughout my findings was that alumni networks often play an important role in cross-sector partnerships in engineering education. University alumni often carry, as one participant described, a 'sense of school spirit' forward with them into their careers post-graduation and are often willing to support partnership activities between their employer and their alma mater. This finding is echoed by prior studies (e.g., Awasthy et al., 2020; Rampersad, 2015; Safrit, 2014) and recognized as creating benefits to organizational relationships such as building community between partners. My conclusions, based on findings related to alumni relationships as presented in chapter four, highlight the role of alumni networks in creating new partnership opportunities and strengthening organizational relationships.

Alumni Create Partnership Opportunities. As indicated in my response to research question one, alumni relations can be a strategic leverage for external partners of universities to establish relationships and form partnerships with universities. University alumni, and particularly recent graduates, often forge many connections throughout their tenure as students with faculty, staff, and peers. Participants in my study described how those connections can lead to new partnership activities with new and existing relationships between employers and their alma mater institutions, a finding supported by existing literature (e.g., Awasthy et al., 2020). Employees who have individual relationships with faculty and staff can leverage their existing rapport to facilitate new partnership activities. Prior studies have found that employees who are alumni of partner institutions can be strong advocates for their employer to those university

individuals (Rampersad, 2015). Employees who have recently graduated from engineering degree programs may have individual relationships with students that can be leveraged. For example, multiple participants talked about bringing employees, who are alumni of partner universities, to career events to interact with students and promote job opportunities with their employers. Prior studies have found that students may be more receptive to recent graduates of their institution when discussing career opportunities (Goldberg et al., 2014). Participants in my study echoed these claims about leveraging alumni networks in support of new partnership opportunities and engagements with universities. Participants who were former students at existing university partners described how their alumni-status enabled relationship development between their employer and their alma mater. As one participant stated, their status as former students created an organic connection between individuals who represent different organizations but share similar goals for supporting student learning at the institution, strengthening their organizational relationships.

Alumni Strengthen Organizational Relationships. As discussed earlier, people are the greatest assets to partnerships. Their individual enthusiasm and personal passion for supporting education-related activities enables organizational relationships to grow and sustain beyond short-term partnership situations. As multiple participants in my study suggested, leveraging alumni relations as a university engagement strategy is a long-term investment. The assumption is that graduates of academic institutions often maintain their identity and association with the institutions long after they graduate. Multiple participants stated that they viewed their roles as university partnership champions as opportunities to 'give back to' or 'serve' or 'stay in touch with' their alma mater institutions by providing learning opportunities to students and supporting curriculum development aligned with industry needs—promoting win-win situations for their

employers and their university partners. Multiple participants who were not alumni of university partners, in the partnership experiences they described during the interviews, suggested that by connecting employees who were alumni of university partners to partnership activities like career fairs and student projects demonstrated their employers' commitment to the university partner and strengthened the relationship between the organizations. The most important takeaway from these findings is that alumni networks are invaluable for forming new partnerships, strengthening existing partnerships, and sustaining organizational relationships over time. Prior studies in the field of engineering education research have made similar claims, but my conclusions contribute new insights and extend the conversations in literature.

5.3 Implications

Although my primary audiences are university professionals who lead, manage, or facilitate engineering education-specific partnerships with organizations outside of academia, my study also provides insights that others may find applicable to their practice, such as university professionals who are interested in forming partnerships outside of their core roles (e.g., a researcher who wants to provide undergraduate engineering students with research or project-based learning opportunity within or outside of coursework), university leadership who may oversee partnership activity but not be directly involved with partnerships, university policy-makers whose efforts may impact partnership activity, external partner champions (e.g., my study participants), leaders, or other professionals who seek to form or improve partnerships with universities, government agencies who seek involvement in partnerships directly or as third-parties of partnerships, organizations who act as third-parties of cross-sector partnerships (e.g., UIDP and BHEF, as discussed in the literature review), and policy-makers at local, state, and federal levels whose efforts may impact cross-sector partnerships in engineering education. In

Appendix C, I propose a set of guiding questions for these two primary stakeholder groups, universities and external partner organizations, to consider when forming new partnerships or assessing existing partnerships.

For Universities. My advice to university champions of partnerships, based on my findings, is to not treat every external partner organization or individual the same way. This advice applies whether you are running a capstone or other project-based learning program, supporting undergraduate students' industry-sponsored research projects or independent studies, soliciting financial or subject-matter support for extracurricular student activities (e.g., competition teams), or any other activity where external partners are involved, and student learning is impacted. Every organization that you partner with will have unique constraints, expectations, desired benefits, experience partnering with universities, perceptions of what partnering means, and other aspects of partnership discussed in my study. What partners tell you may not always align with your initial interpretation of their goals and expectations because of inherent cultural differences (e.g., differing languages used to describe similar aspects of partnerships). Get to know the individual representatives, their company, their industry, and their unique situations relevant to university engagement before assuming they will provide you with the value or benefits you seek and before making commitments.

Along with that same line of thinking, ensure that your potential partner understands your situation and how it connects with higher level university activity. How they approach partnership with you may change based on that understanding, so developing that mutual understanding is critical, particularly in the early stages of forming partnerships. Rather than reacting to what you wish you knew from the start, inform and be informed, be prepared to make partnership attractive to a potential partner who can provide the benefits you seek, and be

prepared to walk away from a potential partner who cannot provide those benefits because of misaligned values, expectations, or other aspects of partnership that are most important to you and your situation. My last piece of advice for university champions is to build lasting relationships at the individual level—get to know your industry counterparts, solicit their ideas, be open to trying new things, try to accommodate their unique needs, demonstrate trustworthy behaviors and keep those connections active, and promote community and a shared vision for mutual benefits regularly.

My advice to university leadership is to create reward structures that incentivize faculty and staff to form and sustain partnerships with external organizations. Performing those roles on their own time is unsustainable and leaves gaps in the process which can contribute to failure. Close those gaps by ensuring that structures are in place to encourage and support partnership activity and afford individuals the time needed to form and implement partnerships. My findings indicate that autonomy within universities can pose challenges for partnerships (e.g., how partnerships are handled for one program, like a capstone program, are often different from others). My advice to university leadership is to create structures and processes that enable coordination among colleges, departments, and programs such that external partners have a consistent and transferable understanding of how to partner with your university, regardless of whether the partnership manifests at the college level or the individual faculty level. Closing the gaps between decentralized structures and processes within the university may not only improve the efficiency and effectiveness of partnerships but also create new partnership opportunities with external organizations.

For External Partners of Universities. My advice to individuals who represent their employers (i.e., champions) in university partnerships, based on my findings, is to develop an

understanding of your partners' goals, how those goals connect to other university goals and initiatives, and how they perceive your role in the partnership. These understandings may not be evident in the initial conversations, but they will have an impact on your goals, your time and resources, and the outcomes of the partnership. Your partners' goals may not come through clearly in initial discussions because of inherent culture and language differences, and it will take time and effort to develop a strong understanding of how your involvement in their education programs and activities align with higher-level goals within the university. For most universities and particularly public, land-grant institutions, there tends to be more autonomy at lower levels than you might expect (e.g., some faculty may have the authority to independently manage partnership activities without the involvement of other university staff or leadership). Although this autonomy within universities can offer several advantages (e.g., the partnership can move quickly towards informal agreements and implementation), it can also present several challenges. You may be less informed about bureaucratic influences on why or how partnership with you is being pursued (e.g., a faculty member seeks to 'check the box' on educational components of their research activities, per some external funding requirement, and less invested in the activities than you need them to be to achieve desired outcomes) or how your partners' intentions are aligned with other university interests (e.g., a capstone program that operates in isolation from college-level initiatives for those programs, potentially isolating you from other opportunities). If you have or pursue new partnership activities with other faculty, programs, departments, or colleges, their structures and processes for partnerships may be entirely different, potentially leading to inefficiencies in resource use and disconnections between your desired outcomes and what is feasible for each partnership situation. Seek out dedicated partnership staff (e.g., industry

liaisons) at universities to help guide you through opportunities and understand the situations of each program you are considering for partnership.

My advice to external partners of universities is to consider whether the support or involvement of senior leadership within your organization makes sense for each partnership situation. For partnerships that involve a single activity (e.g., sponsoring a capstone project), this type of support may not be necessary unless the interest is in growing a portfolio of projects or expanding relationships for other partnership interests over time. For partnerships that involve multiple activities (e.g., multiple sponsored capstone projects, guest speaking engagements, advisory board memberships, student information sessions, and career fairs, etc.), senior leadership support and involvement can make a significant difference in the outcome of the partnership between your organization and the university. Their relationships with university leaders can create new partnership opportunities, enable strategic alignment of activities, and streamline administrative and operational processes (e.g., centralized funding distributed through university channels, rather than decentralized approaches with differing processes which can create administrative challenges). As I proposed in the key findings section earlier, individual relationships drive partnership processes. You must be intentional to develop those relationships, from the lowest levels (e.g., an engineer who represents your organization and directly supports student learning activities in collaboration with a faculty member) to the highest (e.g., an executive sponsor from your organization who interacts directly with department heads, deans, and other university leaders), to enable long-term success in multi-faceted partnerships. As my findings indicate, the people who may be your greatest assets to university partnerships are those with a personal enthusiasm or passion for supporting student learning or the broader academic community. University alumni you employ can be a great asset to your overall partnership

strategy—they can identify and develop strong individual relationships within universities which can lead to new opportunities and build trust between the organizations. My last piece of advice for external partners of universities is to recognize that there may always be a tension between what you seek to gain through partnership and what is feasible because of differing missions, needs, and goals. I suggest that you focus on developing a shared understanding of goals between partners, identify overlaps, and lean into those common goals, values, and understandings as the anchoring points of your relationship.

For Policy-Makers. My advice to policy-makers in government and academia is to treat cross-sector partnerships on engineering education as strategic ecosystem investments. Policies should be co-created with industry and academic stakeholders, tested through pilot programs and evidence-building studies, and designed in ways that enable sustainability, shared governance, and regulatory support. Creating forums (e.g., working groups and councils) on workforce development strategies aligned with partnerships in engineering education can create opportunities for co-designed programs and regulations with stakeholder input and support. Offering competitive grants for pilot testing innovative partnership models (e.g., programs like the 'learning factory' model as one participant described) may be a productive strategy toward incentivizing cross-sector partnerships in engineering education. As indicated in my findings, partnerships can experience conflict over intellectual property ownership and the sharing of proprietary or sensitive information. Policy actions that promote evidence-based models for handling these knowledge resources of partnerships can reduce those administrative burdens and create opportunities for streamlining contractual agreements (e.g., a university policy on NDAs that covers all education-related partnership activity).

My advice for government policy-makers (e.g., local, state, and federal government agencies that support engineering education through partnerships) is to create practical pathways for ecosystem development. Supportive government policy, such as seed grants that build capacity for partnership activity between industry and academia (e.g., enable the creation of dedicated liaison roles in organizations and institutions), can reduce barriers to collaboration for organizational partners. Other approaches that government policy-makers could consider include creating incentive programs that encourage industry and academia to adopt validated partnership models and share knowledge (e.g., through required reporting or publication), and investing in hubs, labs, forums, and cross-sector programs that enable partnership ecosystems to be developed and sustained over time. Policy designed in collaboration with industry and academic stakeholders that incentivizes and supports cross-sector partnerships in engineering education is needed to improve the workforce readiness of undergraduate engineering students—creating economic benefits and advancing the United States' global competitiveness in technology innovation.

5.4 Contributions

My study provides a process-oriented perspective on cross-sector partnerships (CSPs) in engineering education, revealing how these types of partnerships are formed, implemented, and managed day-to-day through the perspectives of individuals representing external partners of universities. It contributes new knowledge to partnerships literature, engineering education research, theory development relevant to inter-organizational relationships, and research design methods relevant to studies of cross-sector partnerships. First, my findings provide new insight into existing literary conversations on CSPs such as how we classify partnerships (e.g., research- versus education-focused partnerships), how we understand the 'third space' of partnerships (i.e.,

the role of the champion as described in my findings), how we conceptualize the lifecycle of partnerships, and how we place partnerships on different continua (e.g., transactional versus strategic partnerships). Second, our current understanding of CSPs in engineering education is limited to a select number of case studies (e.g., Gillen et al., 2021; Lamancusa et a., 2006; Thune, 2010), systematic reviews (e.g., Ankrah & Al-Tabbaa, 2015; Lucietto et al., 2020; Shah & Gillen, 2023; Sjöö & Hellström, 2019; Vuoriainen et al., 2024), whitepapers (e.g., Eddy, 2010; Morell, 2014), and dissertations (e.g., Campbell, 2017; Gillen, 2019; Schaefer, 2022; Young, 2017). My study contributes new knowledge and understanding to this growing field of inquiry in engineering education research. Third, the application of theory in my study (i.e., how I viewed the CSP situation in engineering education and interpreted data) provides new insight for related theory development—bridging collaboration theory with organizational theory. Finally, the combination of methods I employed in my study (i.e., how I generated data about the CSP situation in engineering education and performed data analyses) informs how methodological choices impact study findings (i.e., what I was able to say about my data was constrained by the methods I used). These sets of contributions generate new knowledge, extend existing knowledge and conversations in research, and establish a foundation for future research.

Contributions to Partnerships Literature. Existing classification systems for CSPs, as discussed in my literature review, informed how I oriented my study within the literature on partnerships and how I scoped my study to the engineering education situation of CSPs. I chose two categories, research partnerships and education partnerships, to make distinctions between common manifestations of CSPs in engineering education (i.e., partnerships tend to be either research-focused or education-focused). An assumption implicit in that decision was that why and how external organizations partner with engineering colleges would vary between those two

partnership situations. Making this distinction was consistent with how other researchers have proposed similar classification systems for the interaction between organizations in CSPs (e.g., Ankrah & Al-Tabbaa, 2015). My study extends this way of thinking about CSPs by highlighting the intersections and overlaps between research-partnership and education-partnership situations because of how participants in my study described their partnership experiences and their employers' strategies for university engagement. My study also brings in the idea that career opportunities may have distinct characteristics from the education-partnership situation, in terms of antecedents to partnerships and collaboration processes, and may be considered a separate category of partnership (i.e., career fairs, company information sessions, sponsorship of student extra-curricular learning experiences like competition teams, and similar activities have distinct processes from education-focused partnerships) in future studies.

In the literature review, I discussed partnership continua such as the continuum from cooperative to collaborative interactions between organizations, and the continuum from transactional to strategic partnerships as proposed by prior studies (e.g., Campbell, 2017; Marinho et al., 2020; Rios, 2022). However, my study did not often distinguish participants' experiences in those terms. Instead, I recruited study participants who could speak to multi-faceted partnership experiences under the assumption that they were more likely to be collaborative and strategic, as discussed in chapter three. What I found was that these types of distinctions were not easily determined, which informs how the design of a study enables the degree to which these types of distinctions may be revealed. The 'third space' of partnerships, as discussed in the literature review (e.g., Veles et al., 2018), was deeply considered in my study. My findings provided new insights into 'the role of the champion' in CSPs in engineering education and extended existing conversations in literature. My study also provided new insights

into the lifecycle of partnerships through findings that addressed antecedents of partnerships beyond what prior studies have found, and through the focus on collaboration processes typically absent from studies of CSPs (Ankrah & Al-Tabbaa, 2015; Carbone et al., 2016; Kunttu, 2017; Perkmann et al., 2013). In the literature review, I explored the challenges and best practices of CSPs. My findings both extended what we know about these aspects of partnerships and provided new knowledge for challenges (e.g., operational challenges discussed in chapter four are less addressed by prior studies) and best practices (e.g., recognizing value frameworks, also less addressed by prior studies).

Contributions to Engineering Education Research. My findings extend several existing conversations in engineering education research—building on related discussions presented in chapter four. Gillen and colleagues' (2021) study results provided insight into stakeholder perceptions of collaboration processes in a cross-sector partnership, highlighting different types of tensions evident between partners (i.e., insight into the organizational autonomy process dimension). My findings provide new insights into the tensions they described for 'balancing costs and benefits'—participants in my study talked about how what they sought to gain through partnership did not always align with their university partners' goals (e.g., the tangible benefits they expected from student project activities did not match up with the emphasis on learning from their university partners, as discussed earlier). In another engineering education research example, Thune (2010) presented a 'success factors' model as an output of her study on CSPs in the Norwegian context—organizational factors, contextual factors, and process factors that enable successful outcomes of partnerships. Thune (2010) described contextual factors like how I presented antecedents to partnerships—there are factors that influence organizations' choice of partners. She suggested that 'complementary competencies'

may be less important for CSP situations beyond research-focused collaborations. However, my findings indicate that complementary competencies are important to some external partner organizations for education-focused partnerships (e.g., participants in my study described choosing partners for education-related activity based on research commonality and the types of degree programs offered by institutions). Thune (2010) also found that geographical proximity may be important for education-related partnerships but without offering evidence. My findings provide insights to support her claim (e.g., participants in my study described how proximity is a key factor in partner selection). Multiple findings are consistent between my study and Thune's (2010), such as the importance of communication and situational awareness in establishing governance, and my study provides additional evidence for those organizational- and process-factors (as she described them).

Shah and Gillen's (2023) systematic literature review of CSPs in engineering education highlighted multiple gaps in existing literature that my study helps to fill. First, these authors found that little prior work has been done to understand the motivations and goals of partners in CSPs on engineering education. My findings provide insight into the 'antecedents to partnership' from the non-academic partners' perspective such as access to students, promoting corporate brands, and others as described in chapter four. Shah and Gillen's (2023) review also indicated that few studies of CSPs in engineering look beyond the capstone and internship situations. My study focused on what takes place within the purview of the university and considered advisory board participation, guest speaking engagements, collaborative workshops, non-traditional project-based learning models, and other education-focused situations of CSPs beyond the capstone situation—providing broader sets of insights than prior work. Shah and Gillen (2023) also found that existing literature on CSPs in engineering education lacks theoretical

underpinnings and particularly the use of organizational theory to frame studies of CSPs, a finding also supported by Ankrah and Al-Tabbaa's (2015) systematic literature review. My study employed inter-organizational collaboration (IOC) theory explicitly with integration of distinct theoretical constructs in the study design, analysis, and presentation of findings—making new contributions to theory development relevant to partnership studies.

Contributions to Theory. As indicated in chapter two discussions on theory, Thomson and Perry's (2006) inter-organizational collaboration (IOC) theory is built on the foundational work of collaboration theory (e.g., Gray, 1989; Wood & Gray, 1991), negotiated order theory (e.g., Day & Day, 1997), and other foundational theories of inter-organizational relationships (IORs). IOC theory provides a nuanced perspective on collaboration processes within IORs, which are often perceived as a 'black box' (Wood & Gray, 1991) in prior studies of partnerships (i.e., the inputs and outputs are more easily understood than what takes place within partnerships). The theoretical model of IOC is composed of *Five Dimensions of Collaboration*, as proposed by the authors (Thomson & Perry, 2006; Thomson et al., 2007)—governance, administration, organizational autonomy, mutuality, and norms of trust and reciprocity (also norms of reputation, which is not always included in the 'norms' dimension explicitly). IOC theory has limited prior application in the context of CSPs in engineering education. My study generated insight into this context which may inform future development of IOC theory, although my study did not seek to develop theory explicitly. My application of IOC theory may help future scholars continue to advance how we apply related IOR theories in new contexts and situations.

As mentioned in chapter three, I had originally proposed a sixth dimension of collaboration; individual autonomy. My thinking was that participants would talk about how

their own agency (i.e., acting on behalf of their own personal interests and not just those of their employers) might have an impact on their partnership experiences. I asked questions (as shown in Appendix A) about individual autonomy as a form of agency and distinct from organizational autonomy. However, participant responses to these questions did not align with my expectations and instead offered insights that led to findings for research question one (e.g., individual motivations can influence organizational partnerships, which does not provide insight specific to individual agency about the collaboration process). The difference between what I anticipated and what was discovered in the analysis, with respect to methodological choices I made in the research design, provides insight into how IOC theory may be further developed in future studies.

I also discovered nuances about the *Five Dimensions of Collaboration* constructs themselves that are less evident in existing literature. For example, Gillen and colleagues (2021) found that for the governance and administration process dimensions, formal mechanisms were less evident in their participants' perspectives than informal mechanisms. However, my findings suggest that formal mechanisms were more evident in how external partners described their partnership experiences (e.g., participants in my study indicated their desire for administrative structures and interfaces that create efficiencies in the implementation of partnerships). My findings also suggest that relationship dynamics are evident within the governance process dimension, as building blocks of governance (e.g., my findings that indicate developing situational awareness and inter-organizational chemistry happens at both the organizational and individual levels)—offering new insight that contrasts prior studies that often associate these dynamics exclusively with the norms process dimension (Sedgwick, 2017). Gillen and colleagues (2021) also described a central issue of organizational autonomy in their study as

industry participants balanced their normal responsibilities with the needs of the partnership. My findings offer a different perspective on what may be most critical for organizational autonomy—balancing the goals and expectations of external partners with the goals and expectations of their university partners—generating new insight into the autonomy dimension of IOC theory. My findings for this process-dimension also offer new insight into how different units within organizations can experience different tensions between organizational self-interests and the collective interests of the partnerships (e.g., business-value and mission-value sought by different units within a single organization). Roberts and colleagues (2017) sought to validate Thomson, Perry, and Miller's (2007) IOC instrument (i.e., their validated questionnaire, as described in chapter two) in the South African context. Their findings included insight into the 'norms of trust and reciprocity' process dimension, with evidence that suggests trust relies on each party's perception of their partners' capability and likelihood to deliver on commitments. Participants in my study talked about trust in a similar way but also provided insight into how trust is formed between partners (e.g., transparency in communications and repeat performances) and how relationships are maintained over time (e.g., continuity of relationships enabled by predictability and demonstrating a willingness to exceed minimal obligations, and in-person engagement).

Contributions that my study makes to advance IOC theory may also inform ideas for an updated survey instrument (or derivatives, such as the interview protocol employed by my study), originally developed by Thomson, Perry, and Miller (2007) (see Table 2 on pages 40-41 of their article). My findings for the governance process dimension highlight the situatedness of partnerships, which is not explicitly addressed by the original instrument. I propose additional items for the instrument to explore the situatedness of partnerships:

"Partner organizations understand your organization's unique constraints."

"Your organization understands partner organizations' unique constraints."

My findings for the governance process dimension also highlight the need for goals and expectations to be articulated by partners, which is not explicitly addressed by the original instrument. I propose additional items for the instrument that explore these value frameworks (as described by my study) of partners:

"Your organization understands the goals of partner organizations for pursuing partnerships (i.e., why they partner, not specific to any unique partnership)."

"Partner organizations understand your organization's goals for pursuing partnerships (i.e., why you partner, not specific to any unique partnership)."

My findings for the organizational autonomy process dimension illuminate a different perspective on partnership tensions than what the original survey items address—how internal structures and relationships within a partner organization can impact a partnership (e.g., my findings for 'challenges with university-internal relationships' in chapter four). I propose additional items for the instrument to surface these tensions:

"Differing interests of internal units within partner organizations pose unique challenges to your organization."

"Differing interests of internal units within your organization pose unique challenges to partner organizations."

These kinds of additions to the original survey instrument developed by Thomson, Perry, and Miller (2007) may enhance the measurement of collaboration processes within partnerships—providing a more nuanced understanding of what takes place in these processes.

My findings extend the collective understanding of how each theoretical construct of IOC theory manifests in different partnership situations—supporting future efforts to continue advancing related theories and tailoring those efforts to unique contexts. How I structured my research design was heavily influenced by my application of IOC theory—I leaned on Thomson, Perry, and Miller's (2007) work to develop my interview protocol and employed theory-driven (i.e., deductive) analysis techniques based on the *Five Dimensions of Collaboration*, as discussed in chapter three. My application of theory also informed methodological decisions made for generating data, interpreting data, and presenting findings in my study.

Contributions to Methods. I designed my study following the guidance of multiple qualitative researchers (e.g., Creswell, 2013; Guba & Lincoln, 2005; Hatch, 2002; Maxwell, 2008) and leaned heavily on an approach to thematic analysis proposed by Braun and Clarke (2013, 2022) called reflexive thematic analysis (RTA). The core tenants of the RTA approach include a critical orientation to research (i.e., leaning into researcher subjectivity as a resource rather than as a source of bias that should be mitigated) and applying 'fully qualitative' techniques within a qualitative research paradigm (i.e., conducting research in a way that is philosophically and methodologically consistent with the core principles of qualitative inquiry), as discussed in chapter three. My application of RTA techniques may be considered more 'in the spirit of' the epistemological and ontological perspectives of what Braun and Clarke (2013) describe for research that is 'fully qualitative,' rather than wholesale adoption of the techniques proposed by those authors. More plainly, while my philosophical orientations were consistent with how Braun and Clarke (2013, 2022) describe RTA, my design choices demonstrated several deviations from their approach. For example, I discovered early on in my analysis that I preferred a more 'topic summary' approach to presenting findings that addressed research

questions one and three because I wanted them to be more recognizable to my target audience, as discussed in chapter four. I also chose to headline my findings in my response to research question two with concept names instead of theme names under the same rationale, a departure from Braun and Clarke's (2022) suggested approach for presenting findings. My decisions were grounded in the purpose of my study, my evolving 'qualitative sensibility' (i.e., tailoring my methodological choices to what I felt made sense for my study purpose and questions), and my creative approach to developing findings that would resonate with readers.

The unique blend of methods employed in my study may support how future researchers develop thematic analysis as a qualitative methodology—how I integrated methods to develop my findings may inspire others to explore a mix of methods they feel is most appropriate for their research purposes, rather than wholesale adoption of one methodology. Braun and Clarke (2022) strongly encourage researchers to adapt their methods, techniques, and processes as needed for their specific research purposes. Although it may have served my research purpose in a different way to have followed the RTA approach more explicitly (e.g., thematically-derived findings across all my research questions may have provided readers with different types of insights, some of which may have been more applicable to their situations), I believe my approach demonstrates a balance between leveraging well-established methods and creative decision-making for combining and tailoring methods to a specific research context, purpose, and set of questions.

5.5 Future Work

My study generated insights into how external partners of engineering education describe their partnership experiences in terms of collaboration processes. There are multiple opportunities to expand this type of inquiry to continue advancing the theoretical and practical

understanding of CSPs in engineering education. I have divided my recommendations for future research into four discussion topics: 1) bringing in the university partners' perspective on partnerships, 2) exploring the full lifecycle of partnerships, 3) conducting large-scale studies of partnerships, and 4) studying reward and incentive structures for partnerships. I also conclude this section by discussing future opportunities to build directly on my study.

Bring in the University Partners' Perspective. My focus on the external partner perspective only provided a one-sided perspective on the partnership experiences described by my study participants, limiting what can be understood about those partnership situations holistically. Future research should consider incorporating the university partners' perspective to develop a more comprehensive understanding of what takes place in partnership situations, between both partners, and explore the convergence and divergence of each partner's storytelling to reveal deeper insights into collaboration processes. Such a design would follow Gillen and colleagues' (2021) case study of three partner entities—industry, K-12 teachers, and a university—working together on bringing engineering topics into secondary education classrooms. Although I conducted my study through a lens of collaboration theory, collaboration implies multiple parties and by exploring multiple parties' perspectives, more conclusive findings may be generated than what my study offers. My study design, however, was intentionally one-sided—targeting universities as my primary audience and providing insight into partnerships exclusively through the perspectives of outside perspectives (i.e., giving voice to external partners of universities). Future studies could also exclusively develop insights for the university perspective on collaboration processes in the context of engineering education and make comparisons to my findings—offering a different type of perspective such as convergence and divergence of ideas between academia and external sector organizations on similar

partnership situations. Future studies could consider exploring the full lifecycle of partnerships (i.e., from formation to dissolution or rejuvenation) from the external partners' perspective, the university partners' perspective, or a combination of both perspectives as suggested earlier.

Explore the Full Lifecycle of Partnerships. My focus on collaboration processes within partnerships initially excluded the 'inputs and outputs' of partnerships, although as discussed in chapter three, my study design unexpectedly presented the opportunity for data to be generated related to partnership inputs (i.e., antecedents to partnerships). My approach left a gap in our understanding of all three 'critical issues of collaboration' as proposed by Wood and Gray (1991)—not considering the outcomes of partnerships. Future studies could consider exploring the outcomes of partnerships to develop a more comprehensive understanding of these three issues. What may be missing from Wood and Gray's (1991) model is evaluation—the outcomes of partnerships as evidence to inform future inputs (i.e., a feedback model). Little work has been done to understand how CSPs in engineering education are evaluated. This situation presents another gap in our understanding of the full lifecycle of partnerships and future studies could explore how the outcomes of partnerships inform future partnership activities through evaluation. A few insights that can be gleaned from my study, related to evaluation, include my discussion earlier on repeat performances where realizing outcomes desired of external partners can positively influence their decisions to form new partnerships in the future. Other findings presented in chapter four allude to partnerships becoming easier over time (i.e., reduction in administrative challenges and less time to establish governance in partnerships) and through repeat engagements. Future studies could seek those types of insights to develop a better understanding of partnership evaluation. Little prior work has been done to understand how partnerships end, although some studies indicate reasons such as partnership no longer being

useful to one partner or the other (Adams & Lanford, 2021; Morris & Miller-Stevens, 2016). My study did not explore this topic of ending partnerships, and future studies could consider that type of focus to extend that conversation in research. There are many opportunities for future studies to consider the full lifecycle of partnerships from the different types of lifecycle perspectives I have presented, each with the potential to generate new knowledge of the CSP situation in engineering education.

Large-Scale Studies of Cross-Sector Partnerships. An inherent limitation of qualitative research studies like mine, as discussed in chapter three, are the small sample sizes (i.e., as compared to typical quantitative studies), although for my study each participant offered a high-level view of the partnership system. Although the smaller size of my study was advantageous to developing a narrative-rich qualitative dataset (i.e., deep exploration of participant experiences), my findings may only be directly applicable to a portion of CSPs in engineering education. Large-scale studies, either quantitative, qualitative, or some combination, that explore CSP models or collaboration processes within CSPs, may be able to generate insights with greater transferability (i.e., applicable to more CSP situations than my study). For example, a quantitative survey study of partnership champions, exploring aspects of partnerships like my study, may be easier to generate a larger dataset with a comparable amount of time and effort. These are just a few of the opportunities to conduct large-scale studies of CSPs in engineering education with the potential to generate new knowledge in a way that my study did not. I also propose that a large-scale study of policies that impact CSPs in engineering education is needed, whether independent of exploring the interactions between partners or in combination with that type of design (i.e., a policy study could exclude the interaction space and exclusively consider the inputs-outputs aspects of partnerships or include all aspects including the interactions). Little

work has been done to develop an understanding of how policies of academia, industry, government, or other parties to CSPs in engineering education enable or inhibit partnership formation, processes, or sustainability over time. As discussed in chapter three, I originally intended to explore policy impacts on partnerships in my study, although my data did not support the development of relevant insights. Future studies should consider how policy is explored, as my application of theory in the research design may have unintentionally inhibited the generation of policy insights, or otherwise new strategies are needed to generate data that address policy impacts on partnerships.

Explore Reward and Incentive Structures. The antecedents to partnerships described by my participants included individual motivation as an influencer of organizational partnerships, as discussed in my response to research question one. The types of reasons my participants cited for their participation in partnerships included personal passions for supporting student learning, supporting education systems, and generating new knowledge that could lead to tangible benefits for their employers. Some participants indicated they perform their partnership champion roles on their own time. Only a partial story is told through my dataset that speaks about why individuals chose to participate in CSPs in engineering education. We know very little about the reward and incentives structures within or beyond their employers that lead individuals to participate. What we do know was presented in the literature review, such as creating networking opportunities for individual representatives of external partners (Eddy, 2010) and project management experience for junior staff engineers (Morell, 2014). What I presented in my findings does not offer a strong understanding of organizational structures that reward or incentivize participation in engineering education-related CSPs. Similarly, we know very little about university reward and incentive structures for faculty, staff, and administrators to form or

participate in CSPs in engineering education. Future studies could consider these structures exclusively, or the external partner situation exclusively, or a combination of the two to generate new knowledge. I framed my study in chapter one as addressing societal challenges for engineering workforce development and how CSPs in engineering education are one way to provide solutions, and along that line of thinking we (both the engineering education practice and research communities) need a better understanding of how organizations and institutions incentivize and reward the formation and implementation of CSPs in engineering education.

Opportunities to Build on My Study. There are several opportunities to build on this research. ***First***, my study design considered both the positive and negative sentiment of study participants towards university partnerships, through their story-telling of both positive and negative experiences. My results did not illuminate differences between those two types of experiences because the sentiment was often mixed throughout their story-telling. However, future studies could more explicitly address this dyad by incorporating related design and analyses techniques (e.g., sentiment analysis). ***Second***, my study viewed all partnership situations through a lens of collaboration theory, even though not all situations may be considered fully 'collaborative' (see full discussion on this topic in the literature review). This design decision allowed for insights to be developed that transcended different types of partnership arrangements. However, future studies could more explicitly address the distinctions between cooperation, coordination, and collaboration and how those arrangements influence each process dimension for different partnership situations. ***Third***, my study did not offer nuance for the 'collective interest' of partnership situations described by my study participants. The collective interests, as described in the organizational autonomy dimension section of my results, of those partnership situations was more implied (e.g., workforce readiness of engineering

graduates, as discussed in the introduction) than nuanced through a deeper exploration of each partnership situation. Future studies that seek a more nuanced understanding of collective interests could consider modifying the questions used in my interview protocol (e.g., the addition of the prompt "describe the shared goal of the partnership").

Fourth, in the preceding section on contributions to theory, I note how a sixth dimension of collaboration was originally intended to be measured by my study: individual autonomy. Although my study design did not provide evidence to support the addition of this dimension, future studies could continue exploring the original line of thinking inspired by the literature review (i.e., an individual's control and authority and the potential impact on partnerships) through deeper exploration of an individual's authority to drive organizational activity (e.g., the additions of the prompt "describe your individual authority to make decisions on behalf of your employer"). ***Fifth***, my study was specific to cross-sector partnerships in engineering education, but future studies could look beyond the engineering education situation to consider relevancy in other disciplines. Many of my study findings that apply in the engineering education context may also apply to other disciplines where external organization involvement is common (e.g., a comparison with nursing education, where external partnerships are common, in terms of collaboration processes) or desired (e.g., in programs that are looking to expand experiential learning opportunities for students). ***Finally***, as noted previously, future studies that seek to build on my research could consider expanding the questionnaire from Thomson, Perry, and Miller (2007), incorporating some of my findings, to better address aspects of collaboration processes that were further nuanced by study.

5.6 Conclusion

Cross-sector partnerships in engineering education are complex—there are many different organizational and individual factors at play in those situations. My study helps to illuminate the complexities of partnerships through my interpretation of how twenty individuals, who represented unique organizations in their partnerships with universities, described their partnership experiences. Partnerships often fail (Ankrah & Al-Tabbaa, 2015; Campbell, 2017; Eddy, 2010; Prigge & Torraco, 2006) because of inherent differences between organizational missions, values, needs, and goals. However, we recognize their importance in engineering education in addressing the engineering workforce development challenges we face past, present, and future (Awasthy et al., 2020; BHEF, 2018; Eddy, 2010; Gray & Purdy, 2018; O'Leary et al., 2023). CSPs in engineering education help to bridge the gap between what students learn and what they are expected to do upon entry into the workforce (Lucietto et al., 2020; Tembrevilla et al., 2023). My study provides insight into the collaboration processes of partnerships, often overlooked in studies of partnerships (Ankrah & Al-Tabbaa, 2015; Carbone et al., 2016; Kunttu, 2017; Perkmann et al., 2013), through the lived experiences of external partners to inform how practitioners in engineering education implement CSPs to advance academic agendas and enhance the workforce readiness of engineering graduates. My study results and conclusions may continue to gain relevancy for higher education as the importance of external partnerships and experiential learning continues to grow. CSPs in engineering education as a field of inquiry is growing in response to the increasing pressure on institutions to deliver a workforce capable of addressing complex societal and technological challenges, and my study provides a foundation for future research to build on as we collectively strive for a better understanding of what makes these types of partnerships successful.

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Appendix A: Interview Protocol

Ask explicitly: *Do you have any questions about the study or your rights as a participant?*

Ask explicitly: *Do you consent to participate in this study?*

1. Broad Experiences (5 minutes)

Tell me about your background and education partnership experiences.

2. Collaboration Processes for a Positive Case (20 minutes)

Tell me about a partnership situation that you think went well.

(Governance) *Tell me about the initial discussions with the university individuals.*

- *How the goals and objectives were defined.*

(Administration) *Tell me about your role and responsibilities throughout the partnership.*

- *Who you worked with and how those individual relationships evolved.*

(Organizational Autonomy) *Tell me more about your employer's goals.*

- *What your employer expected from the university partners and vice versa.*

(Individual Autonomy) *Tell me more about your personal goals.*

- *How your personal interests and ideas may have influenced the partnership.*

(Mutuality) *Tell me about the working relationships you develop with individuals.*

- *How did you and your partners make one another feel appreciated and respected.*

(Norms) *Tell me about the importance of trust between you and your partners.*

- *The willingness of you and your partners to do more than what was expected.*

3. Collaboration Processes for a Negative Case (20 minutes)

Tell me about a partnership situation that you think did not go well.

- Repeat the above question set from Part 2 for the Dimensions of Collaboration.

4. Considerations for How Partnerships Vary over Time (5 minutes)

- *Think about the two partnership situations we have discussed. How do you feel the situation would be different, for you or your partners, if taken place before COVID.*
- *What types of situational changes are you seeing this year, if any.*

5. Broad Advice and Best Practices (10 minutes)

- *What advice would you give to a university that is interested in forming an education partnership with your company? Why?*
- *What do you feel are the best practices for education partnerships? Why?*

Appendix B: Example Journal Entry

June 5, 2025 -- Reflection on Coding Process

Thursday, June 5, 2025 8:30 AM

Reflecting on my coding process after going through first two interviews

I've finished coding through the first two interview transcripts. It seems like a good time to reflect on how that's going. I already feel like my codes are far too descriptive and I'll probably end up with a low ratio of codes to quotes. But these code labels are fine for now, since I'll probably go back through later and refine those, and feel confident that I am catching information relevant to my research question. My approach has been to have the audio recording playing, have my transcript in ATLAS open and walking through that alongside the audio, cleaning up my transcript and lookup tables as I go, reflecting on the notes I took during the interview, making memos, and applying code labels. There is so much going on at once and it takes a LONG time (like eight hours each, at least). I have to pause and play the audio dozens of times. But I feel really good about this approach. It forces me to be really in-depth with each conversation. I didn't start the first transcript until later in the day and it was hard to pick back up the next day, so I started over. I found that I am needing to dedicate a whole day to each interview without any other distractions. But I think this process will pay off in the long run so if I need to revise my code labels, I shouldn't have to go back through this whole process for each interview. We will see what happens as I keep going.

So that was process, but I also want to reflect on my memos so far and what I'm seeing in the data. These memos (like one-page summaries of my codes and reflection after finishing a full pass through an interview) are going to be important later to make sure I'm capturing the essence of ideas when I generate themes. These first two interviews were quite different, one was a participant, who I have assigned the alias Josiah, who represents a large for-profit company and is a senior-level leader, and the other was Alex (alias) who represents a defense contractor and also a senior-level leader (but an engineer, unlike Josiah who is like a senior program manager). They had very different things to say about their partnership experiences with universities on education-related activity. Josiah talked a lot about how student projects should generate meaningful value to his employer, which was surprising because I didn't expect participants would talk about those types of benefits. Alex's perspective was more along the lines of my expectations, where student project activity 'might' move the needle for tangible value to a business but the primary goal is recruiting and relationship development. Both participants talked about how their university partnerships were strategic and included research partnerships, education partnerships, and recruiting, and working with a wide variety of programs across their partner institutions. Both talked about how prior relationships were a critical part of sourcing new project activities, but Alex took this a step further and talked about how those relationships can also present challenges because of past activity that didn't meet his expectations and hindered future activity.

Josiah emphasized NDA processes and IP ownership but Alex didn't seem to think those were so important. Josiah even indicated that schools who have really strict policies on IP are less attractive as potential partners, even for the education situation. Josiah also talked about how regional talent development was important for their university partnerships strategy, so there may be an element of proximity that matters to certain organizations. Alex didn't talk about that as much, but then again, his company is so large and distributed that perhaps that is a factor. I'll have to look for those types of insights as I go and maybe probe a little on that with participants I haven't interviewed yet. Both participants felt strongly that in-person engagement and face-to-face interaction were critical to successful partnerships, something I did expect to hear but not as strongly as they indicated, and I definitely want to probe on that idea more with future interviews. I think the last big idea, so far and something that both Josiah and Alex talked about, is how executive involvement supports strategic university partnerships. Both indicated that these individuals enable new partnership activity, provide oversight and direction, and can help reduce administrative burden on relationships (like getting funding pushed through, agreements installed, etc.). Alex also mentioned that for some senior leaders, their involvement is more symbolic and that isn't always ideal or helpful.

This has been an enjoyable (although exhausting, I'll admit) process of going through my data. I'm capturing ideas in a way I didn't expect, and some that I did expect, and overall feel like I'm approaching the conversations with fresh eyes and perspective than when the interviews were actually taking place. I still have a lot to learn to build confidence during the interview events. These reflections help. I think that's it for now. I have another interview to code through today!

Appendix C: Guidance for Partnership Champions

Consider the following when forming new partnerships or assessing existing partnerships.

For industry partnership liaison personnel at universities.

- What is the history of the external partners involvement with the university?
- What relationships and individual connections exist with the external partner? How are those being nurtured and supported?
- Does the external partner understand how your initiative connects with broader programmatic, departmental, and/or institutional initiatives?
- Do you have a strong understanding of your external partner's motivations for participating in your initiative? Your expectations for their involvement?
- How are university personnel involved in this partnership incentivized and supported?
- Do you and your partner have a mutual understanding of success for this initiative that is specific to the partnership and to each partner's independent goals?

For university partnership liaison personnel at university-external organizations.

- What is the history of your organization's involvement with the university?
- What relationships and individual connections exist with the university? How are those being nurtured and supported?
- Does the university partner understand the structures, constraints, and priorities of your organization and how those connect to your university partnership strategy?
- Do you have a strong understanding of your university partner's motivations for soliciting your participation in their initiatives? Their expectations for your involvement?
- What are the roles and responsibilities of employees in your organization who are involved with the university partner?
- Does senior leadership support make sense for this university partner?
- Do you and your partner have a mutual understanding of success for this initiative that is specific to the partnership and to each partner's independent goals?