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Exploring the Constitutive and Social Processes of Ethics in Multidisciplinary Engineering Design Teams

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EXPLORING THE CONSTITUTIVE AND SOCIAL PROCESSES OF ETHICS IN MULTIDISCIPLINARY ENGINEERING DESIGN TEAMS

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For my parents and Scott. You are my guiding lights.

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ABSTRACT

Kenny Feister, Megan. Ph.D., Purdue University, August 2015. Exploring the Constitutive and Social Processes of Ethics in Multidisciplinary Engineering Design Teams. Major Professor: Patrice M. Buzzanell.

This study seeks to examine the communicative constitution of ethics in team-based design projects in an engineering education context. Engineering and design work involve complex social processes and ethical decision-making activities and collaboration (Bucciarelli, 2010). The understanding and development of ethics in future engineers is a primary concern for engineering educators, students, and the governing bodies that oversee this field (ABET, 2013; NAE, 2012). Specifically, given the highly fluid and subjective nature of ethics and the complications of the team-based context, challenges arise about how to move beyond codes and standards that are intended to guide ethical conduct (ASEE, 2012; NSPE, 2011) and encourage ethical orientations in future engineers that may help them guide themselves.

This project contends that a communicative approach can help to unravel some of the social and communicative processes underlying ethical perceptions and relations in a team-based context. This dissertation contributes to a communicative understanding of ethics in student engineering design teams as a constitutive process in which project participants make sense of, discuss, and construct individually and in teams their understandings of design and the role of ethics in design considerations.

Utilizing a mixed-methods approach combining social network analysis (Wasserman & Faust, 1994) and a discursive approach (Potter & Wetherell, 1987; Fairhurst & Putnam, 2004), this study probes how ethics are interwoven into design work. This study also highlights the social and relational factors underlying ethical team-based project work. By conceptualizing ethics through the "everyday ethics" approach (van de Poel & Verbeek, 2006), ethics is communicatively constituted and interwoven throughout the design process.

The findings suggest that ethics is understood and handled distinctly in these teams from other design considerations. Students struggled to articulate or identify ethics in their own projects, and failed to recognize other team members as ethical resources on a large scale. However, while their explicit talk and organizing around ethics suggested that students did not recognize or understand it in great depth and related to their particular teams, analysis of team members' discursive practices throughout their descriptions of their experiences on these teams showed a human-centered orientation toward design that directed them toward ethical considerations. These findings suggest that ethics is evaluated and handled very differently from other design-related considerations by the members of these project teams, and offer practical and theoretical implications to the fields of organizational communication and engineering education. As a result, the constitutive communication and everyday ethics lenses in project-based design work offers insight into the ongoing construction of design and ethical considerations, thus filling a gap in current engineering ethics approaches and in team communication scholarship.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Ethics in engineering project teams has long been a focus of scholarly attention and engineering practice as well as part of the Accreditation Board for Engineering and Technology (ABET) accreditation criteria for engineering and technology (ABET, 2013). Engineering is increasingly recognized as a social activity (Bucciarelli, 2010) requiring interaction and collaboration with diverse groups of people (NAE, 2011). Engineering's new complexities raise important questions not only about how engineers make ethical decisions and develop ethical team climates, but also how communication constitutes the very nature of ethics within the project-based team context. Specifically, challenges arise about how to move beyond established professional codes of ethics (NSPE, 2011) that lack the specific guidance needed to help engineers make ethically-justifiable decisions consistently, leaving room for subjective interpretations and differences in perceptions and interactions.

This dissertation project contends that a communication lens is not only appropriate, but is needed to provide insight into the study of ethics in the engineering education context. Ethics is a subjective and fluid concept, which I argue does not exist in isolation, but rather is communicatively constituted within project teams. Its

understanding and importance in an engineering education context is dependent on the interactions of team members, the institutional forces present such as organizational discourse and literature framing the projects, and the requirements and concerns of the project itself. Given the communicatively constitutive nature of engineering ethics, questions arise about how ethics itself is conceptualized, manifest, and confronted by project teams--that is, how ethics is communicatively constructed by team members, and how ethical decision-making structures *emerge* during team interactions and become integrated in design specifications and solutions. At present, the communicative constitution of ethics in engineering design teams has not been researched. Such scholarly attention to ethical processes and outcomes contributes not only to how the constitutive process emerges in this particular work context but also to how teamwork and knowledge work in general can be enhanced through ethical practices.

1.2 Significance of the Problem

In taking a constitutive approach to engineering ethics, this project focuses on design--how teams and their members discuss and engage with ethics, discursively construct the meanings and significance of ethics, and structure interactions--throughout the design process. In a constitutive approach, guided by social constructionism and grounded in the communication is constitutive of organizing approach, organizations are seen as discursive constructions that are brought forth through communication (Fairhurst & Putnam, 2004). This project contributes to understanding how *everyday ethics* is communicatively constituted and interwoven throughout the design process, which current literature suggests students do not recognize (Davis & Riley, 2008; van de Poel & Verbeek, 2006). Indeed, scholars argue that ethical issues arise on a day-to-day basis and

are implicit throughout the design process (van de Poel & Verbeek, 2006). Students are largely unaware that they are engaging in ethical design processes at all, in part because existing research has largely focused on a scenario approach, in which participants are asked to respond to hypothetical scenarios that often are perceived as unrealistic (Kline, 2001). This study answers the call for naturalistic research in group ethics (see Cheney, May, & Munshi, 2011) by examining engineering design teams as they work through their actual design process. While group communication research has long debated the relationship between individuals, teams, and ethics, studies have failed to examine the decision-making process itself, instead focusing on ethics as an outcome or as an effect. This project offers insight into how ethical concerns and issues are handled *in practice*, and how team interactions, discussions, and individual and team-level moral reasoning factor in to the team's overall decisions regarding ethics. The "everyday ethics" approach assists with this effort, requiring that researchers and team members pay close attention to design itself through micro decision-making processes and values reintegration into the everyday life of end users.

Finally, this project contributes to theoretical understanding of the structure of ethical interaction in engineering project teams through examination of networks (Wasserman & Faust, 1994). Social network analysis enables examination of communication patterns that emerge from organizational interactions, revealing communication and relations among team members *in practice.* This dissertation combines social network findings with those from interview data to gain students' perspectives and descriptions of those interaction patterns and their view of the role ethics has to play. In better understanding the individual-engineering team network

structures, this study provides insight into how teams become more effective and accountable for their actions by reinforcing that their design work involves anticipating unethical decisions that could produce harm to potential design users and their communities as well as the organizations for which engineers work (Trevino, Butterfield, & McCabe, 1998).

1.3 Organization of Dissertation

In the following chapter, I outline the theoretical framework for this project. I discuss the metatheoretical lens guiding this project, social constructionism, as well as the communicative constitution of organizations approach that enables me to look at language and interaction as the central principle for organizing. I discuss design and engineering ethics, particularly describing the "everyday ethics" approach that guides this study, as well as small group communication research that relates to this topic. Finally, I overview the analytic approaches for this study, namely, discursive psychology, and social network analysis.

In Chapter 3, I discuss the methodology for this project. I review the overall research program and research design, and discuss the metatheoretical approach, procedures, and analytic method for each of the three parts: Part I consists of a social network analysis; Part II includes semi-structured interviews and a discourse analysis of the interview text; and Part III, in which I synthesize the findings from the first two parts and consider them in conjunction with one another and in light of the theoretical framework guiding this study.

Chapter 4 presents the findings of these analyses. In this section, I present the findings that emerged from my examination of the three research questions that guide this

dissertation project. I began by using a social network approach to explore my first research question, which probed the structures that emerged around technical, program, friendship, and ethical relations in these teams. I found that the technical and program networks in Class A were statistically different from the ethical network, and the patterns of relations that emerged in the network centralization measures and degree centrality measures for individual actors suggested some distinctions in how team member competencies were evaluated.

Second, I conducted a qualitative discourse analysis to examine my second research question, which asked how those four constructs were communicatively constituted through the talk of team members. I found that students articulated distinct conceptualizations of technical, program, friendship, and ethical relations in their teams. Students appealed to different justifications for their characterization of team members as technically, programmatically, or ethically competent, and valued and evaluated friendship in distinct ways. While they were able to offer ample evidence and justifications for describing a team member as technically or programmatically competent, ethical competence often proved difficult for students to articulate and justify. Additionally, students struggled to describe the role and importance of ethical competence in their teams.

Finally, I used a discursive approach to answer my last research question, which asked how "everyday ethics" was communicatively constituted in both the talk and informal patterns of relations that emerged on these teams. While their explicit talk about ethics suggested that students did not recognize or understand it, analysis of their discursive practices throughout their descriptions of their experiences on these teams

showed a human-centered orientation toward design that inherently directed them toward ethical considerations.

Chapter 5 presents a discussion of these findings and considers the contributions and implications of those findings in light of past research and theory. Drawing from qualitative discursive analysis and quantitative social network analysis, I found that ethics seems to be perceived distinctly from other considerations in design work. In addition, ethics may be influenced by a human-centered orientation toward design.

In this final chapter, I consider the implications and lessons learned from this dissertation project's findings. I also discuss some of the limitations and challenges faced in this research, and present future lines of inquiry that can advance the exploration of this topic.

CHAPTER 2. CONCEPTUAL FRAMEWORK

2.1 Introduction

In this chapter, I review the extant literature on which this project is constructed. I first discuss the metatheoretical framework for this study, social constructionism, which guides the theoretical assumptions for this project. I discuss how this study fits into the existing literature about design and engineering ethics, particularly illuminating design as a social process and the "everyday ethics" approach to understanding engineering ethics. I also locate my study within relevant group communication research and existing understandings of team performance and decision-making to provide context for analyzing students' descriptions of team-based work. After this, I discuss the analytic approaches for this study, discursive psychology (Potter & Wetherell, 1987) and social network analysis (Wasserman & Faust, 1994). Finally, I conclude with a summary of the research questions for this study.

2.2 Social Constructionist Approach

This study is grounded in a metatheoretical approach called social constructionism. This section reviews the meaning and assumptions of this approach and explains its utility for this project. In this approach, meaning arises from "social systems, rather than from individual members of society" (Allen, 2005, p. 35). Reality in this approach is not a fixed "thing" existing "out there" for research to discover; rather, reality

is constantly being created by members of social systems. The five metatheoretical commitments of this approach are important foundations for the current project because they shape my approach to the data, framing both my examination and interpretation. The metatheoretical commitments of a scholar's approach define my positionality within the research and illuminate the underlying assumptions that guide my examination of this topic. In this section, I discuss the metatheoretical commitments and how they impact my approach to this work.

First, social constructionism rejects the view that scientific theory and inquiry serves to reflect reality without regard for context. It rejects the domination of the empirical, claiming that there is more to knowledge than that. For example, emotion terms do not exist "out there" and independent, but rather get their meaning from their context of usage (Gergen, 1985). Language does not reflect reality, but rather is an essential component in shaping and defining that reality for those using it. Words themselves are socially and historically situated; we as researchers must get at the historical and cultural bases to truly conduct an analysis.

Second, social constructionism approaches ontology by accepting that there are multiple realities, rather than one "Truth" that exists. That is, "realities exist in the form of multiple mental constructions, socially and experientially based, local and specific, dependent for their form and content on the persons who hold them" (Guba, 1990, p. 27). A central component of a social constructionist perspective is the idea that reality and meaning are negotiated (Gergen, 1985). Truth or reality is not objective, existing "out there," nor is it completely subjective and specific to each individual. Rather, truth is

socially constructed; we negotiate understandings and come to shared meanings that then constitute what we conceive to be and operate under as truth.

Third, a social constructionist approach puts language at the center of meaning and understanding of society. Allen (2005) argues that this theory is particularly suited for studying the process of organizing, which involved the production and reproduction of organizational norms. Accordingly, communication and language are critical for teams to be successful, and a social constructionist approach allows for a close examination of the ways in which teams shape and are shaped by the realities created by their use of language. I argue that this approach is a productive way to approach social interaction, and it affords a great deal of agency and influence in how they make sense of and participate in their daily lives.

Fourth, as I discuss in a later section, ethics is a highly subjective concept that is fluid and ever-changing. A social constructionist approach affords the opportunity to focus on participants' language to gain insights about how ethics and ethical issues are socially constructed and managed through team interactions and communication. That is, rather than examining ethics as an output of the team process, or as a variable to be factored into its workings, ethics is seen as interwoven throughout the team process and communicatively constructed and attended to by team members constantly.

Finally, as an interpretive scholar, I am rooted in this social constructionist perspective (Allen, 2005), and as such see my purpose as attending to how *all* participants handle their language use and how they work together to construct a sense of reality. Following the sense that reality is rooted in social interaction, of which we are all a part, the epistemological and axiological stance of this approach contends that the

researcher is as much a part of the social reality as his or her participants. That is, I reject the post-positivist notion that theory and research should be value-free and objective, with the researcher striving to remove his or her values and beliefs from the research process (Miller, 2001). Instead, I conceive of research as fundamentally theory-laden, with the researcher's values and beliefs as a natural part of the research process. Researchers approaching a study from this perspective advocate a "subjectivist epistemology," meaning that researchers strive to give local understandings and specific knowledge (Deetz, 2001). Thus, rather than seeking to uncover universal truths and consensus about the social world, I seek a more local knowledge and strive to understand more specific events. This approach also offers opportunities to organizational communication research and efforts to provide understandings of how the realities, opportunities, and constraints of organizations, and their members are constituted communicatively by organizational members.

2.2.1 Constitutive View of Organizations

For this project a social constructionist view operated as the guiding metatheoretical approach. This approach views organizations as discursive constructions constituted through communication (Fairhurst & Putnam, 2004; McPhee & Zaug, 2000). This approach contends that communication constitutes and sustains organizations, rather than conceptualizing organizational reality as a fixed entity.

McPhee and Zaug (2000) offer a structurational approach to a constitutive lens, offering four specific interrelated communicative processes that constitute organizations: membership negotiation, organizational self-structuring, activity coordination, and institutional positioning. *Membership negotiation* refers to relationships of members to

the organization, in which the person and the organization subtly redefine themselves to fit the other's expectations. *Organizational self-structuring* refers to any interactions that steer an organization in a particular direction. *Activity coordination* focuses directly on connecting and shaping work processes, such as working out solutions to problems or coordinating how to avoid work. *Institutional positioning* focuses on organizations and their societal interactions with suppliers, customers, competitors, and other stakeholders. This positioning involves identity negotiation in finding the organization's place in a larger social system. A social constructionist approach offers a framework for probing specifically *how* organizations are constituted by these different components of communication.

This approach has been applied to various organizational settings to help explain events that were otherwise elusive. Fairhurst, Cooren, and Cahill (2002) examined a company that went through successive downsizings in order to consider the tensions and contradictions in organizational life. They found through the accounts of their participants and analysis of archival data that some of the repeated failures of the downsizing efforts were elucidated by identification of conflicting and contradictory discourses. The authors define *tensions* and *contradictions* based on definitions offered by Stohl and Cheney (2001): *tensions* as the clash of ideas, principles, and actions as well as feelings of discomfort; where c*ontradictions* are "ideas, principles, and actions in direct opposition to one another that exert tensions within a process" (p. 506). Contradictions, they argue, are constructed through discursive acts, and are thus the "building blocks of our organizational world" (p. 506). In their case, tensions emerged when expectations of being hired with an idea of lifetime employment were challenged

when faced with the prospect of downsizing, which essentially contradicted this initial expectation of long-term commitment. This study offered a constructionist approach to contradiction, offering an empirical demonstration of contradictions in organizations as a result of contradictory demands placed on the organization.

While the above study focused on organizational change, a process in which contradictions and differing perceptions are inherent, the current study argues that the project design process may also be fraught with contradictions as team members seek to accomplish a task while negotiating their own opinions and those being offered to them through the engineering education context (e.g., from program literature, advisors, and the discourses shaping the program context). In the current study, an emphasis on contradictions can help my examination of ethics in project design teams by identifying tensions or contradictions that emerge, especially in opposition to ethics. For example, one common tension that may emerge is the tension between budget or efficiency and ethics.

This tension emerged in Larson and Tompkins' (2005) study of JAR, a high-tech company undergoing organizational change, in which the authors applied a discursive lens to examine why an organizational change effort was unsuccessful. Due to the economy and various external factors, JAR had just attempted to change the organizational culture to promote new values and goals. It was supposed to shift from a "high-reliability organization," with the core value of technical excellence and "getting the job done at any cost," to a more market-controlled, customer-driven organization with the core values of efficiency, cost, and providing the "best value." This change was not entirely effective, and the implementation and communication of the change caused

resistance and tension throughout the company. Organizational members struggled to manage the tension between budgetary concerns and efficiency of the "best value" discourse, requiring faster production and the use of lower-cost materials necessitated by the market climate of their industry, and the "successful past" discourse, which promoted the value of producing the highest-quality products with the highest technical excellence, even if it meant taking a little more time. This study illuminates both how a discursive approach can offer great insights into organizational life, as well as how a discursive analysis can help to uncover tensions that may affect the behavior and decision-making of organizational members. In the design context of this study, these tensions are certainly present, and may impact the handling of ethics.

An important note in the discussion of constructionist approaches in organizational communication is the urging of moderation in analysis. Alvesson and Kärreman (2011) recently issued a call for scholars to avoid the discursive bias in the study of organizations, which essentializes communication and the study of organizations to only what individuals *say* about them. Instead, they call for a thorough consideration of the material, including the materialities and contradictions that may be present. Thus, while this study relies heavily on qualitative approaches and a constitutive approach guiding a discursive analysis, I also employ a quantitative angle in order to provide additional insights from which to draw conclusions about these project teams. In analyzing the data collected for this project, I employ a discursive approach that compliments a constructionist approach and embodies the principles of social constructionism: discursive psychology.

2.2.2 Discursive Psychology

This approach draws from constructionist roots, which is a distinct tradition in the study of communication in its emphasis on language (Fairhurst & Putnam, 2004). Discursive psychology is a type of discourse analysis that was first introduced by Potter and Wetherell (1987). While its constructionist roots are of primary concern for understanding and application of a discursive psychological approach, it is also useful to present a history of its development and its treatment of discourse. Discursive psychology was developed as an opposing view to its contemporary traditional psychological perspectives, which were largely rooted in cognitive psychology. Studies from the cognitive psychology perspective take an *etic* view, seeing talk as an expression of an individual's inner workings, thoughts, and psychological states. Psychological states and processes in this view are "revealed" or evidenced by social action--that is, cognitive psychological studies may view discourse as something to "see past," so that researchers can "get at" the individual's true beliefs and attitudes (Edwards, 2003). Researchers from this approach often focus on giving a technical account of these actual psychological states that underpin and partly explain action.

Discursive psychology takes a contrasting approach to psychological issues, relying on the belief that reality and psychological phenomena are constructed through language and acted out in social contexts. Drawing from a social constructionist paradigm, this approach locates the creation of meaning and reality *in* social interaction, contending that individuals as social actors *actively create* reality and shape identities through their talk. In a discursive psychological approach, descriptions of psychological and social objects are studied for the way social actors invoke them in the course of

certain communicative activities, such as blaming or complimenting (Potter, 2005). In this view, "the psychological categories that make up the mental thesaurus can be studied as a kitbag of resources for doing things" (Potter, 2005, p. 740). Given this understanding of psychology and social interaction, discursive psychology focuses on the way reality and the world of the mind are *constructed* by social actors through language, throughout the course of their everyday execution of practical communicative tasks (Potter & Edwards, 2001).

Drawing on this constructionist perspective, discursive psychology is uniquely positioned to challenge, yet complement, two previous approaches to discourse analysis. In contrasting its treatment of discourse with conversation analysis and post-structuralist approaches, we can tease out more precisely the contribution and application of a discourse psychology-guided approach.

2.2.2.1 Conversation Analysis

Conversation analysis focuses on the detailed organizing of talk-in-interaction and the accomplishment of sensemaking in conversation (Heritage, 1995; Sacks, 1992; Schegloff, 1992). This approach examines such procedures as turn taking, member categorization, and agenda setting in interaction, to understand how actors use these different interactional methods to produce their sense of the world. As such, conversation analysts are interested in examining how members make sense of things, as they intersubjectively build social order (Wetherell, 1998).

Some scholars were not fully satisfied with the scope of this type of analysis. Wetherell (1998) claims that conversation analysis is only useful to analyze small pieces

of conversation in detail, and that it rests on an "unnecessarily restrictive notion of analytic description and participants' orientations" (p. 402). She explicates this argument with a metaphor, saying that conversation analysis cuts out a piece of social interaction from the "argumentative social fabric" for analysis, and then promptly disregards the argumentative "threads" which make the very foundation of the interaction and connect the piece back to the greater cloth of society. This call for more attention to the discursive context in which language is used is one of the central motivations of a discursive psychological approach.

Wetherell (1998) argues that conversation analysis alone is not able to offer an adequate answer to the important question a researcher should ask about a piece of discourse: "why this utterance, here?" (p. 388). That is, what is being accomplished by the precise use of language? Discursive psychology attempts to broaden the scope of the analysis by recognizing that discourse is always embedded in socio-historical, local, and contingent social practices that define a particular context, concepts explored more fully in Foucault's (1980) conception of genealogy. Wetherell argues that this genealogical approach suggests that in seeking to analyze their partial piece of the argumentative social fabric, researchers should look also to the broader forms of intelligibility (Discourse) that run through the texture of the fabric more generally (p. 403).

2.2.2.2 Post-structuralist Foucauldian Analysis and Interpretative Repertoires

Potter, Wetherell, Gill, and Edwards (1990) were equally dissatisfied with the Foucauldian view of discourse (represented by the "big D"), which they saw as overly abstract and prone to reification. While these authors acknowledged the importance and

usefulness of this view, they also criticized this it as having become "something akin to the geology of plate tectonics--great plates on the earth's crust circulate and clash together; some plates grind violently together; others slip quietly over top of one another" (p. 209). In other words, Discourse in this view is seen as overly systematized and coherent, reified as "sets of statements" rather than seen as a constitutive part of social practices (Potter et al., 1990). Discursive psychologists sought to reframe the significance of Foucault's view and expand on its importance for discourse analysis.

Thus, discursive psychologists attempt to narrow the focus of the Foucauldian view, seeing Discourse instead as a "constitutive part of social practices that are situated in specific contexts" (Potter et al., 1990, p. 209). They argue that Discourses function as *interpretative repertoires* for communicating actors. Interpretative repertoires can be defined as "culturally familiar and habitual line[s] of argument comprised of recognizable themes, common places and tropes" (Wetherell, 1998, p. 400) and may order social realities and inform social practices (Alvesson & Kärreman, 2000).

In essence, interpretative repertoires can be identified generally as clusters of terms, descriptions, figures of speech, and "clichés" that are often used with metaphor or vivid imagery, and often have distinct grammatical construction and style (Potter et al., 1990). The authors compare this concept to a ballet dancer's repertoire of positions and moves, but they substitute terms, tropes, metaphor, themes, and habitual forms of argument (Potter et al., 1990). These "moves" function as the social actor's tools for sensemaking in a particular context (Fairhurst, 2007, p. 109). Through this understanding, we as researchers can view interpretative repertoires as discursive resources for social actors in their effort to understand and create identity within multiple competing

Discourses. We can identify or infer the presence of Discourses through actors' linguistic choices (in discourse), as they are invoked through the familiar terminology, stories, and lines of argument.

2.2.2.3 Application of Discursive Psychological Approach

Drawing from the critique and reevaluation of these other types of analysis, discursive psychology seeks to offer a "more synthetic approach" (Wetherell, 1998, p. 388), which seeks to ground Discourse (envisioned as interpretative repertoires) in discursive practices (or language in use). It draws from both the fine-grained analysis influenced by conversation analysis and a more global analysis inspired by post-structuralism and Foucault (Wetherell & Edley, 1999). In so doing, this form of discourse analysis does not limit itself as conversation analysis does, nor does it overly broaden or make abstract the Discourse at work in the analysis.

While organizational discourse analysis is a useful and productive tool for understanding the social and communicative aspects of organizational life, its application must be careful and precise in order to avoid some of the potential pitfalls. Alvesson and Kärreman (2011) identified a number of concerns and inconsistencies in the way discourse analysis has been applied by communication scholars. In some cases, discourse analysis is used to conduct superficial analyses (what the authors call "armchair research), making grand claims from very limited or thin material. The term discourse itself can be used in a vague and meaningless way, sometimes referring to language; other times to artifacts of culture; occasionally as a vague and cryptic allusion to some all-powerful force that controls the world and everything in it; and in some cases, as a

catch-all to describe everything that is not physically rooted in the tangible (p. 1195). The authors call for scholars using a discursive approach to be reflexive and

> move between a theoretical assumption and an observation, considering the advantages and disadvantages of various theoretical understandings and concepts to understand and creatively, as well as fairly, make sense of whatever is being studied. (p. 1196)

Further, they call for a greater emphasis on using discourse analysis to explore how organizational members "navigate social reality and create, use and mobilize discursive resources" (p. 1198).

In acknowledgement of the criticisms and calls offered by an extensive and growing body of discourse scholars, I employ a constructionist approach that draws from both a discourse analytic perspective as well as social network theory to examine not only language use in the context of engineering design teams, but also how students embedded in this context discursively constitute design work and ethics, and how they draw from and contribute to the development of various discursive resources in producing an understanding of design and their place in it. An analysis driven by this approach enables me to explore how ethics is socially and communicatively created and handled, as well as the interplay between participants' talk and the various institutional forces that may be implicit in these constructions.

2.3 Design and Engineering Ethics

Many definitions of design have been offered throughout the literature. Dym, Agogino, Eris, Frey, and Leifer (2005) describe design thinking as "the complex processes of inquiry and learning that designers perform in a systems context, making

decisions as they proceed, often working collaboratively on teams in a social process, and "speaking" several languages with each other (and to themselves)" (p. 104). Bailey, Leonardi, and Chong (2010) examined the social aspects of engineering design as technology interdependence. As design is highly social, ethical concerns are communicatively constituted and encountered by team members constantly throughout the design process. This section discusses the social nature of design and ethical approaches to it.

2.3.1 **Design as a Social Process**

Design has been characterized by many different "design process" models (Atman, Adams, Cardella, Turns, Mosborg, & Saleem 2007; Bennett, 2006; EPICS, 2010; Mosborg, Adams, Kim, Atman, Turns, & Cardella, 2005; Ullman, 2003) and definitions that reflect different design approaches and philosophies. Crismond and Adams (2012) define design as "'goal-directed problem-solving activity' (Archer, 1984) that initiates change in human made things (Jones, 1992), and involves optimizing parameters (Matchett, 1968) and the balancing of trade-offs (AAAS, 2001) to meet targeted users' needs (Gregory, 1966)." Bucciarelli (1996) defines design as "a social process in which individual object worlds interact, and design parameters and ideas are negotiated" (p. 81). This definition highlights the social nature of design, as well as hinting at the communicative element that seems essential in the negotiation of ideas. Finally, Dym et al.,(2005) describe design thinking as "the complex processes of inquiry and learning that designers perform in a systems context, making decisions as they proceed, often working collaboratively on teams in a social process, and "speaking" several languages with each other (and to themselves)" (p. 104). This definition also reflects the social nature of

design, but also highlights the importance of the team context. These definitions allow me to envision design as social in nature, communicatively grounded, and embedded within team processes.

The many design definitions and processes reflect different design approaches, philosophies and values. It has been argued that there has been a recent paradigm shift from "technology-centered design" to "human-centered design" (Krippendorff, 2006). Technology-centered design is defined as a process in which the designers or their clients make design decisions which are imposed on the intended users (Hoffman, Feltovich, Ford, Woods, Klein, & Feltovich, 2002; Krippendorff, 2006). In contrast, human-centered design (HCD) centers human beings in the process, involve users throughout the design process, and seek to understand them holistically (Zhang & Dong, 2008). An IDEO (2011) definition of HCD described the central focus of this approach to design:

> A process and a set of techniques used to create new solutions for the world. Solutions include products, services, environments, organizations, and modes of interaction. The reason this process is called "human-centered" is because it starts with the people we are designing for. (p. 6)

This definition reframes design as *creating solutions,* which implies that the entire purpose of design may be to solve needs or improve the lives of the end users. Indeed, Krippendorff (2006) offers three features that are common to all HCD methods: "(1) they are 'design methods' that employ both divergent and convergent thinking; (2) the processes are concerned with how the stakeholders themselves attribute meaning through the use of the proposed design; and (3) the methods include prototypes and other ways for the stakeholders to test the design ideas themselves since 'a projected future cannot

yet be observed'" (Zoltowski, Oakes, & Cardella, 2012, p. 29). In these three features, two important concepts for this project emerge. First, HCD is concerned with the *processes* and their orientation toward the stakeholder or end user, putting the emphasis on the *process* of design as opposed to strictly the *outcome* or goal. Second, HCD is concerned with how stakeholders *attribute meaning* through the use of the designs. This emphasis on the users' construction of meanings reflects the constitutive approach, positioning communication and discursive constitution at the center of design. Indeed, while this project focuses on how team members discursively construct elements of design related to ethics, it is important to note that this discursive constitution does not end with product delivery. Users are also implicit in the design process and the meaning of that which is being designed.

In the context of design, there are many different values, such as innovation or a primary concern for safety, that guide design decisions and processes, and can impact how designers think about the ethical issues related to their designs and the implications of their "everyday" ethical decisions. In the engineering education context, the design model offered to students can have a significant impact on how they make design decisions, how they prioritize the many and often competing elements of design work, and potentially their future engagement in design work as professional engineers. A human-centered approach is an example of a design value and is intertwined with the design process. For instance, in a phenomenographic study of human-centered design, Zoltowski et al., (2011) were able to identify seven distinct ways that students experience (and understand) human-centered design: technology-centered; service; user as information source input to linear process; keeping the users' needs in mind;

understanding the design in context; commitment to involving stakeholders to understand perspectives; and empathic design. These categories of descriptions demonstrated the different ways students approached and conceived of design. For example, the service conceptualization viewed human-centered design not as design but as service aimed at positively benefiting others.

The most comprehensive category from this study, Empathic Design, was characterized by a very broad and integrated understanding of the stakeholders and the social, cultural, political, technical and ethical issues associated with the design. Design knowledge was gained through a connection with end users, not on preconceived ideas and assumptions, and there was evidence of their consideration of "everyday ethics" throughout their design process.

These different orientations toward design affect how students engage in the design process, whose needs are considered and to what degree, and even their understanding of the overall goal towards which they are working. These findings not only illuminate the complexities of students' perceptions about design, but they also demonstrate the importance of developing effective pedagogy surrounding ethical engagement in design work. This study provides insight into how these orientations develop and are handled communicatively in project-based team work and illuminate the team communication processes that may affect and reflect these orientations.

EPICS, the site for this study, is based off an HCD model for design, encouraging its students to approach design through this lens (Coyle, Jamieson, & Oakes, 2005). This is reflected in the design process model EPICS uses and teaches to its students, shown in Figure 1. Previous research comparing students from project-based engineering

education programs like EPICS in four different universities has suggested that EPICS students drew from a Discourse of Human-Centered Design (HCD), which was characterized by "the framing of specific design considerations in terms of their impact on the user; descriptions of the design process as highly collaborative and interdependent; and a concern for the impact of their work on the greater community" (Kenny Feister, Zoltowski, & Buzzanell, 2014, p. 6).

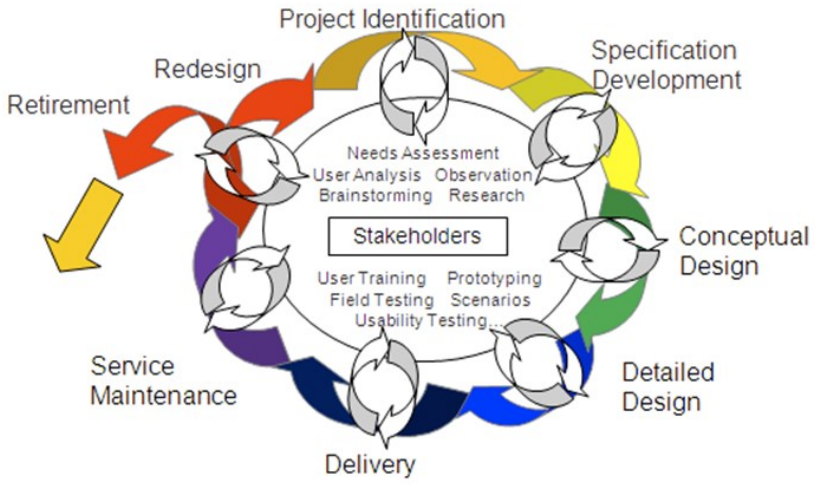

Figure 1: EPICS Design Process (EPICS, 2010)

By using the aspects an HCD model incorporates and highlights in the design process, I have a framework for examining the interests, concerns, and discussions that occur within the project teams in this project. While the emphasis on concern for the human stakeholders who may be impacted by design seems to suggest an ethical orientation, it remains unclear whether an HCD model of design may promote or affect ethical considerations for designers.

2.3.2 Communicative Constitution and "Everyday Ethics"

While the HCD model has an implicit ethical orientation to it, ethics itself has long been a concern for professional engineers as well as engineering educators seeking to shape future engineers. It is formally recognized as a criterion by engineering and technology's accreditation organization, ABET, for effective engineering curriculum (ABET, 2013). Yet scholarship in this area is significantly lacking. Many conceptualizations of ethics have emerged throughout the course of this line of research. One popular theory is Kohlberg's (1984) moral development theory, which attempts to understand how people reason morally and on what values their reasoning processes are based. When adapted to professional engineering, this theory includes three stages: preprofessional, which can involve concerns about advancement and individual gain; professional, which involves loyalty to the firm or the profession itself; and principled professional, which refers to concerns for service to human welfare and appeals to universal justice and fairness (McCuen, 1979; Vesilind & Gunn, 1998). Theories such as these are used to describe and assess the types of concerns, motives, and considerations that go into moral reasoning at an individual level. In the context of engineering education, ethics relates to how the individuals and teams reason and make decisions, including the kinds of considerations they take into account when making those decisions.

Of primary focus in engineering education have been professional codes of ethics, individual moral reasoning, and case studies, often of "disaster scenarios" that highlight the rare major ethical issues that may arise in engineering work (Lloyd & Busby, 2003). These "disaster scenario" and hypothetical case studies are often identified by students as

unrealistic or difficult to relate to in their own experience of engineering (Davis & Riley, 2008; Lloyd & Busbey, 2003).

Engineering design processes do not often include many large and significant ethical decisions that are typical topics or themes in traditional engineering ethics cases, and students often do not realize that they are engaging in ethical processes at all (Davis & Riley, 2008; van de Poel & Verbeek, 2006), nor how the context in which they work shapes and is shaped by their decisions. Indeed, it is often only on looking back "after things turned out nasty" that reasoning originally unrelated to ethics is identified as ethical all along (Lloyd & Busby, 2003, p. 514). From this perspective, on the whole engineering design might not seem to be specifically about what one would traditionally consider to be "ethical issues." However, the *products* of an engineering design process, and especially the use of those products, undoubtedly are (Lloyd & Busby, 2003). Indeed, scholars have argued that ethical issues arise on a day-to-day basis in the engineering design context (van de Poel & Verbeek, 2006), meaning that ethics is implicit throughout design processes. Nuanced micropolitics are interwoven throughout the technical and other decisions that comprise the design process, and all decisions and agreements that emerge through this process could result in social or ethical impacts which must be considered at every stage (Martin & Schinzinger, 2004). This "everyday ethics" approach aligns with the constructionist approach, as ethical concerns from this perspective can also be seen as discursive constructions constituted through communication. This project takes as a starting point that teams and individuals are engaged in ethical deliberations on an ongoing basis through their communication and the discursive construction of the design process itself.

In the current project, the constructionist approach is supplemented by a social network approach that provides insight into the emergent network structures in ethical interactions that shape and are shaped by the development of group norms and patterns of communication in the team. Thus, an exploration of group communication and interaction is required.

2.4 Ethics in Team-Based Work

This study explores a nuanced view of ethics and its role in the design team process itself. That is, I ask how "everyday ethics" is communicatively constructed, as well as how it comes into play in multidisciplinary project teams, in terms of the members' interactions, the structures that emerge from those interactions and the team process itself, as well as in the design decisions and discussions in which the team engages. To understand these interconnections within team processes, this section explores relevant past research on team interactions and small group communication.

Scholars have studied moral and ethical reasoning in both individuals and in group contexts. Following Rest's (1986) Four Component Model, Arnaud (2010) developed a model describing the ethical work climate in which a team is operating that included collective moral sensitivity, collective moral judgment, collective moral motivation, and collective moral character. Additionally, the issue of moral intensity becomes important in both understanding the role of ethics in different contexts such as engineering education, as well as exploring how individuals and groups assess and reason through different ethical dilemmas.

Drawing on Rest's (1986) Four Component model, Jones (1991) developed a model of moral intensity that sought to characterize the moral *issue* that affects ethical

decision-making. Moral intensity is defined as "a construct that captures the extent of issue-related moral imperative in a situation" (Jones, 1991, p. 372). The components of moral intensity are characteristics of a moral issue. These include magnitude of consequences, or the sum of the harms or benefits done to potential victims of the act in question; social consensus, or the degree of social agreement that determines a particular act as good or evil; probability of effect, which considers the likelihood that the act will actually take place and will actually cause harm or benefit; temporal immediacy, which takes into account the length of time between the act and the potential repercussions; proximity, which describes the "feeling of nearness" the individual has for those the act may affect, including social cultural, physical, or psychological elements; and concentration of effect, which relates the given magnitude of the act and the number of potential people it affects (Jones, 1991, p. 376).

Moral intensity focuses on the characteristics of the moral issue that influence ethical decision making, and does not consider the traits of the moral decision maker or organizational factors. The extent to which participants identify with or perceive issues to have effects on individuals or communities might direct their attention to and increase their focus on figuring out what the "right" thing to do might be.

This study examines the communicative mechanisms of ethical decision making in a *team* context. The team context differs significantly from an individual in several important ways. Many scholarly approaches to moral reasoning focus on the individual level. However, this understanding is complicated by the team context, in which moral autonomy in *individual* ethical reasoning is very likely to be affected and restricted by others in the team context. In the team context, individual moral reasoning does not exist

in isolation, but rather must be justified to one's team members with consideration for the reasons others should accept them (van de Poel & Royakkers, 2011). While individual ethical reasoning alone is insufficient to explain the team ethical decision-making process, it is an important component to understanding how teams engage in this process, especially given that team members must have a well-argued moral opinion when engaging in a collective moral deliberation. Research on the *social* ethics in engineering explains how individual ethical reasoning is distinct from team ethical decision making (Devon, 1999). According to Devon (1999), social ethics argues that "the individual may be unhappy with the outcome but be able to accept it because the *process* was perceived as the most acceptable way for a group" (p. 91, emphasis added). While the specific relationship between individual and team ethical decision-making remains murky, this emphasis on the decision-making process within the team highlights the importance of communication to both the outcome of the deliberations and the perceptions of members regarding the path to getting there.

Indeed, in understanding decision-making and ethical reasoning in teams, the role of communication becomes essential in the team context. Often in these studies communication encompasses the verbal messages team members use to share information with each other, but also involves nonverbal factors (such as "body language" and seeming enthusiastic or skeptical), and the relations formed between members as they interact. Several studies have found that the way team members communicate with each other is crucial in determining how they collaborate and the success of those efforts (de Moura, Leader, Pelletier, & Abrams, 2008; Hirokawa, Degooyer, & Valde, 2000; Salazar, 1996). However, the precise role of communication in contributing to a group's success

is still a matter of debate (Meyers & Seibold, 2009), and more extensive work analyzing these effects is needed. Meanwhile, group communication scholars have extensively examined decision-making processes in teams, offering insight into how specific factors such as team characteristics of diversity and status differences affect team communication, decision-making and performance (Larson, 2007; Reimer, Reimer, & Czienskowski, 2009).

2.4.1 Team Performance and Communication

Scholars in small group communication research have found that team member interactions and communication have a major impact on a team's decision-making abilities, as well as the information that is discussed during the problem-solving process (Larson, 2007; Postmes, Spears, & Cihangir, 2001; Putnam & Mumby, 2014; Reimer et al., 2010). For example, Reimer et al. (2010) probed the long-standing finding that groups are more likely to discuss information to which everyone in the team has been exposed. Group discussions favor shared information, rather than members bringing in their own individual knowledge that may assist with the team task. In their study, these authors found that teams with very short (30 minute) time constraints, or with a very limited number of alternatives from which to choose, displayed less of this bias toward shared information. The bias toward discussion of shared information can reduce a team's decision-making abilities and may decrease innovative solution generation. Individual team members can significantly affect the team's performance and influence communication patterns that emerge within the group, such as the way members relate to one another, the type of information that is shared and discussed, and a number of other factors that contribute significantly to a team's functioning and decision-making (Bain et

al., 2001; Barnlund & Haiman, 1960; Dahlinn et al., 2005; Gibb, 1978; Karakowsky & McBey, 2001). This effect is even more pronounced for smaller teams of people (Henley & Price, 2002), such as the multidisciplinary project teams at the center of this project.

Diversity among team members also influences decision-making and the team's performance. Researchers have found that diversity among team members has several implications. First, more diversity in terms of age and educational experience have been linked positively to team performance (Kearney, Gebert & Voelpel, 2009). Additionally, overall, more diverse work groups often produce more flexibility, innovation, and productivity (Miura & Hida, 2004). Diversity may also combat the dangers of groupthink (Janis, 1982), a condition in which a group collectively generates the illusion that they are on the right track or justified and reach a consensus without having first completed the appropriate testing, analysis, and evaluation of ideas. Groupthink can occur in settings in which group members are either extremely agreeable or strive to a great extent to minimize potential conflict, or in which team members are too similar and do not bring new perspectives into the team process. However, despite these benefits, research has also indicated that these more diverse work groups often encounter difficulty, especially at the initiation of the group, in terms of conflict, group performance and functioning (Miura & Hida, 2004).

Diversity also impacts a team's interactions and decision-making processes, offering both benefits and challenges. Some obvious challenges include potential language barriers, but nonverbal cultural differences can also make team interactions more difficult. Cultural diversity can offer more opinions and perspectives on problems (McLeod et al., 1996; Miura & Hida, 2004), and could influence the team to take into

consideration a wider view of the end user of the product or its functionalities. Culture can also impact the development of team norms, the quality of discussion and inclusivity of team members, and the clarity of the decision-making process. EPICS teams, just as the professional world of engineering, are often highly diverse in terms of age, educational background, level of experience with either the specific project or the program in general, and national culture. Diversity is an important consideration for this project in examining ethical reasoning, both within the team and as a product of the team's efforts.

Additionally, trust is critical in ethical team processes (Jones, 1990; Van de Poel & Royakkers, 2011). Trust is highly related to both team effectiveness and other team processes, including social loafing, team conflict, negotiation, and team satisfaction (Borrego, Karlin, McNair & Beddoes, 2013). Scholars defining trust often conceptualize it on two levels: affect-based trust, involving empathy, rapport, and self-disclosure; and cognition-based trust, involving calculated and instrumental assessments of others (McAllister, 1995). Chua, Ingram, and Morris (2008) probed how these two types of trust are associated with network theory. They found that managers' professional networks showed cognition-based trust as associated with network ties relating to economic resources, task advice, and career guidance. Affect-based trust was associated with ties relating to friendship and career guidance. These findings suggest that these types of trust are developed in and influence team and network processes in distinct ways. In this study I explore the team-based, social foundations of design work including the role of these two types of trust in design.

2.4.2 Team Norms and Decision-Making

All of the factors discussed above affect the team decision-making process, but they also importantly contribute to the development of group norms that determine how they interact and collaborate. Norms refer to the rules or standards that help define inappropriate and appropriate behavior in a certain context; they can provide expectations and guide behavior (Postmes et al., 2001). Indeed, research on this subject indicates that group norms affect both group-member relations, as well as the quality of group decisions (Postmes et al., 2001). Group norms are highly dependent on the members themselves in their development. For example, members' styles of dress, style of communication, attitudes and opinions can all have major impacts on the shaping of group norms. In group work, norms can have a major impact on how the team interacts and how productive they can be. For example, if the group develops a norm of being off-track and socializing more than focusing on the task at hand, this norm may increase members' perceptions about their satisfaction or identification with the group, but almost certainly decreases productivity.

Group norms are an essential component of team innovation and creativity. If a group develops norms that encourage free expression and an open working environment, these norms might lead to more innovation because members would feel more comfortable sharing thoughts or ideas (Hersey & Blanchard, 1992). Research has often probed the assumption that groups on the whole are able to generate more novel information and come up with more creative solutions than individuals. There are truths and falsehoods to this claim, each of which have an important impact on our greater understanding of the strength of groups and their relation to innovation.

Indeed, research in this area has shown a clear link between the diversity of a group and the quality of the ideas it can generate (Larson, 2007). However, diversity can also generate conflict, misunderstandings, and disagreements, all of which can hinder or halt a group's performance. On the other extreme, too much group cohesion may result in groupthink, a condition in which a group collectively generates the illusion that they are on the right track or justified and reach a consensus without having first completed the appropriate testing, analysis, and evaluation of ideas. Groupthink can occur in settings in which group members are either extremely agreeable or strive to a great extent to minimize potential conflict. Additionally, depending on the interaction norms and the ability of members to freely share ideas, groups can often have significantly low levels of innovation despite the diversity of members.

Despite these challenges, groups that are functioning efficiently are often able to generate a range of new ideas and enhance old ones through their diversity of perspectives. Supporting Granovetter's (1983) assertion, research on small groups indicates that one major reason why groups are able to make better decisions is that there is a wider range of knowledge and information from which to draw when making decisions (Cooke & Kerrigan, 1987; Postmes et al., 2001). The group norms that develop and communication patterns that emerge as groups form and solidify are major contributors to team performance. These group communication concepts need to be examined to see how they influence the way the team conceptualizes and confronts ethics.

Organizational scholars have also contributed to the investigation of ethics in group communication (for an overview, see Gastil & Sprain, 2011). Issues like social loafing (Latané, Williams, & Harkins, 1979) and groupthink (Janis, 1982) have been

studied extensively and are essential components of ethics in teams. Past research has tried to examine ethical behavior in organizations. Scholars in organizational studies have debated about the root of unethical decision-making and behaviors, arguing whether it is a function of "bad apples" or "bad barrels" (Trevino & Youngblood, 1990), that is, whether individual characteristics or organizational and societal influences are greater contributors to the ethics of decision-making in organizations. More complex models have been developed to describe a complex interaction between these factors, such as a focus on the types of ethical issues and their "moral intensity" in determining ethical responses (Jones, 1991). The importance of relationships among social actors in an organization or team has also emerged as an essential consideration in this debate (Brass, Butterfield, & Skaggs, 1998). However, these studies have failed to examine the decision-making process itself, focusing rather on the outcomes and net effect of these interactions. To address this gap in the literature, this project uses a social network perspective informed by structuration theory to provide a more detailed understanding of the interactions and relations that are formed within these project teams to identify how team structures emerge around ethical and design-related issues.

2.5 Network Structure and Ethical Interactions

In order to explore the interaction side of the issues addressed above, this project combines qualitative methods with a social network perspective informed by structuration theory (Whitbred, Fonti, Steglich, & Contractor, 2011) to provide an understanding of the communicative constitution of ethics in these project teams, as well as how team structures emerge around interactions and relations that are formed within

these project teams that shape and are shaped by those constructions around ethical and design-related issues.

Social network analysis (SNA) is a type of analysis that enables researchers to examine the relationships among members of a given system or group. The network analysis approach enables researchers to create and analyze the informal communicative patterns and networks that underlie the formal organizational structure (Monge & Eisenberg, 1987). In contrast to the "organizational chart" that might show how communication is *supposed* to flow within the organization, network analysis shows the *actual* communication and relationships that emerge within the organization or team.

In this approach, several key terms must be defined (for definitions, see Wasserman & Faust, 1994, ch. 1). *Actors* refer to the social entities, who are the individuals, corporate, or collective social units. *Relational ties* refer to the social ties that link actors to one another. A tie is what establishes a linkage between a pair of actors. Ties can represent a number of different relational linkages, such as behavioral intention, association or affiliation, formal relations, and biological relations, among many others. A *subgroup* is defined as any subset of actors, including the ties among them. This is in contrast to a dyadic or triadic relationship, which consists of two or three people, respectively.

2.5.1 Social Networks and Organizing

Social network analysis (SNA) has been applied to organizational research productively. Kilduff and Brass (2010) articulated four distinctive ideas that distinguish organizational social network research from other kinds of research: (a) an emphasis on relations between actors; (b) the embeddedness of exchange in social relations; (c) the

assumption that dyadic relationships occur not in isolation, but rather form a complex structural pattern of connectivity; and (d) social network connections matter in terms of outcomes to both actors and groups.

First, researchers emphasize that social network analysis focuses on a set of actors and relations, such as friendship, communication, or advice, which separate or connect them. Visualizations of these relations, such as Krackhardt and Hansen's (1993) visualization of the advice and trust network in a company, can illustrate the importance of the presence and absence of social relations among actors. In this way, SNA research offers a powerful tool to organizational communication research by emphasizing the relationships that underlie organizational structure, communication patterns, and ultimately organizational functioning. In the example of Krackhardt and Hansen's (1993) study, this visualization was able to offer insight into why certain management structures did or did not work, as well as revealing who *in practice* was seen as an authority on the project team. Indeed, in this study, the authors found that the wrong person had been appointed to lead the project team, resulting in tension within the group, because the appointed leader was not central in the trust network--meaning that others on the team did not trust in him, and therefore were not likely to rely on him as a leader. In this way, SNA can be used to explain and predict practical concerns that organizations face, as well as being able to describe and illuminate the patterns of relations that actually emerge in organizational life.

Second, an SNA approach considers the concept of *embeddedness* of exchange in social relations. Kilduff and Brass (2010) define embeddedness as the extent to which actors "show a preference for repeat transactions with network members and to the extent

that social ties are forged, renewed, and even extended through the community rather than through actors outside the community" (p. 9). Embeddedness highlights the tendency of individuals or organizations to form alliances and exchange resources based on interpersonal relationship development such as relations of friendship or trust. The concept of embeddedness assumes that people rely on social connections and the exchange of resources to make important decisions; in other words, organizational behavior is embedded in social structures (Uzzi, 1996). This author notes that in his study, the small number of employees at the firms he examined and the personal nature of the inter-firm ties in that industry may have provided an especially productive site for studying embeddedness that may not hold for larger firms (Uzzi, 1996). This argument is especially important to the present study, which takes smaller project teams and their interactions within and among them. Embeddedness has a number of positive implications, such as higher levels of trust, richer transfers of information, and greater problem-solving capabilities. Relatedly, challenges of working with small groups and social network data are discussed further on in the dissertation.

A third unique advantage of a social network analysis approach is the important assumption that dyadic relationships do not occur in isolation. Rather, this perspective allows researchers to contextualize dyadic relationships as elements of a complex structural pattern of connectivity (Kilduff & Brass, 2010, p. 11). Related to this assumption is the concept of structural patterning, or the assumption that beneath the complexity of social relations, enduring patterns of connectivity can be revealed to help explain outcomes at different levels. This assumption enables the researcher to study the whole and parts of social networks simultaneously (Wellman, 1988). By approaching the

analysis on a number of levels, such as examining dyads, cliques, and larger structures or components, researchers are able to simultaneously address actor, group, and network characteristics, including the *lack* of ties between actors. In the specific research context of EPICS teams, this perspective enables the researcher to examine issue of ethics at the individual level, within individual project teams (or even at the dyad or triad level, if applicable), as well as examining project teams as parts of the larger group. When two people interact, they may represent not only themselves, but also any formal or informal groups or organizations of which they are members.

Finally, SNA follows the belief that social networks provide opportunities and constraints that affect outcomes of importance to individuals and groups—that is, social interaction does matter. One perspective under this umbrella focuses on the collectivity, not the individual actor, to assess how groups of actors collectively build relationships that provide benefits to the group (Kilduff & Brass, 2010). This perspective puts emphasis on norms, trust, and reciprocity in social networks that can result from network closure associated with structural holes, in which some actors are not connected directly.

This study follows Whitbred et al.'s (2011) approach that combines social network analysis with structuration theory. A structuration approach emphasizes several important concepts: *structure, rules,* and the *duality of structure*. *Structure* refers to the rules and resources that actors follow when operating within the practices of a given system, while *rules* are principles and routines that guide people's actions (Whitbred et al., 2011). The *duality of structure* concept views individuals in groups and organizations as both using the existing structural rules within a social system as guides for how to behave, think, and interact, but also sees those behaviors and interactions as reproducing

and creating the system that shapes them (Whitbred et al., 2011, p. 407). Thus, individuals and the systems in which they are acting reflexively shape one another in complex ways. This approach enables me to examine the structure of project teams while also examining the institutional and contextual factors that contribute to team climate, and to the development of group norms that affect team interactions. Structuration accounts for the influence of institutional factors such as rules, or norms of what is "acceptable" or "appropriate" behavior within a specific social context, while also affording the actors within that context agency to enact influence on those structural influences. This theory envisions a reflexive relationship in which institutional influences constrain and enable individual activity, while individual activity reinforces these structures and shapes them over time. Network analysis provides a concrete visualization of this relationship, showing the relational patterns of individuals to both identify local structural properties and utilize these properties to help predict and explain changes in the network structure (Whitbred et al., 2011). Using this approach, I look at how structure or the rules and resources individuals can follow when they enact the practices of the system or institution of which they are a part. For example, the EPICS human-centered design process provides both context and structure for individual and team ethical decision-making and interactions related to design. In analyzing the results of this project, I explore the reciprocal nature of how structure may impact the patterns of the emergent communication network that then becomes the structure in which ethical decision making occurs.

Different network structures have been found to affect employability, employee turnover, employee satisfaction, and creativity (Granovetter, 1983; Krakhardt & Hanson,

1993). However, how specific measures of density and centrality in team network structures emerge around ethics in design work is not known. Indeed, Whitbred et al. (2011) recommend that "future research should focus on establishing whether the structuration of social networks will vary depending on the nature of the organization and, if so, which structural rules would emerge as being most important in these other contexts" (p. 425) particularly useful for engineering design teams. This dissertation study follows Whitbred et al.'s call as well as that of Katz, Lazer, Arrow, and Contractor (2004) to apply network theory to small groups in order to better understand team-based work phenomena. I advance these efforts by presenting a mixed methods approach, putting social network analysis into conversation with extensive interview data to enrich my interpretation and understanding of how team interactions and patterns of communication emerge and are handled discursively.

I chose to examine four important concepts related to the types of relations that are important to team-based project work and engineering design: technical, program, and ethical competence, and friendship. As was discussed in the above sections, there are multiple and sometimes competing orientations toward design that can influence how team members work together and what they find most salient about their work—potentially affecting the components of design they privilege and those they marginalize. Following the three tenets of IDEO's (2011) human-centered design approach, desirability, feasibility and viability, I examine three important aspects of design work that relate to technical skills and feasibility, marketability and program or organizational constraints that constitute viability, and the ethical component of caring for and advocating on behalf of the human users at the end of the design road, which is

represented by desirability. Technical knowledge is a well-established component of engineering design work and would play an important role in these teams, especially given that they are situated in an engineering education context and working constantly to develop their technical competence as engineers. EPICS has a strong organizational identity as a service-learning program and programs of its kind are often recognized as a unique entity within the world of engineering education, because they focus on real-world application of design learning to specific community partners. Additionally, organizational constraints are always a consideration with engineering work, with teams tasked to complete advanced projects with limited resources, time, and budgets. Thus, I examine the program-specific competence as perceived by the participants. Finally, the overarching goal of this project is the examination of ethics, which occupies a specific role in a human-centered model of design. I explore the team-level and project-level manifestations of ethics in these teams and how ethics is communicatively constituted and valued. I utilize two levels of network measurements to probe these relations in a network approach.

2.6 Two Levels of Network Measurements

Several elements of social network analysis are important for this study because they provide insight into the strength, linkages, and patterns of team networks. I examine team network structure on two levels, those that describe the network as a whole (network density) and those that give information about the participation of individual actors in the network (measures of centrality). In this section, I outline the definitions of these measures and the scholarly links that prompted me to focus on these specific measures for my analysis.

2.6.1 Network Density

Density of a network refers to the percent of ties that exist compared to the total number of possible ties (Wasserman & Faust, 1994). A highly dense network indicates that the actors are all communicating with one another frequently, generating more opportunities for information, opinions, and values to be shared (Wasserman & Faust, 1994). Density is a network structure that captures the pattern of interaction and connections that give a unique insight to the study of social phenomenon (Balkundi & Harrison, 2006). Examining the density of a network and comparing density across different networks gives insight into how much members of that network interact with one another around a specific construct, such as work-related talk or levels of trust, as Krackhardt and Hansen (1993) explored.

Examining network density may provide insight into team ethics. For example, in a meta-analysis of 37 studies of teams in natural settings, Balkundi and Harrison (2006) found that teams with highly dense interpersonal ties are able to attain their goals and are more committed to staying together. As density relates to levels of interaction between the members of the network, it stands to reason that highly dense networks would have higher levels of information sharing and potentially engage in more collaboration, both of which contribute to successful completion of tasks.

However, scholars in this area do not take this as a foregone conclusion. Indeed, some have posited a theoretical counterargument that highly dense networks may have *lower* successful task completion because of the effort individuals must expend in maintaining numerous ties (Shaw, 1964). Indeed, in the case of expressive ties (as opposed to instrumental), there is a high potential for socializing and other non-team-

related activities that could be distracting to the group's overall goals. Krackhardt (1999) has also argued that expressive ties may encourage member conformity (related to the issue of groupthink, discussed above), as members would tend to share only "acceptable" ideas with the team that conform to team norms. Thus, this project seeks to explore how density might relate to ethical processes in teams.

2.6.2 Measures of Centrality

Network position refers to an actor's position within the network in relation to others. There are several measures of network positions, but for this study I focus on measures of degree centrality. Centrality refers to the extent to which an actor is central in the network, capturing the relational aspects of actors' positions within the entire network. Examining centrality in the exploration of ethics in team-based work makes sense in part because centrality captures the extent of an individual's access to certain kinds of resources within the network, including task-specific knowledge or information about the project and its history (Sparrowe, Liden, Wayne, & Kraimer, 2001). Research suggests that actors who are in strategic locations within the network may have more opportunities and fewer constraints, and could signal the prominence, importance, or power of the actors (Ibarra, 1992). For example, more central individuals may have greater control over the flow of information and resources.

Degree centrality refers to the number of direct ties a node has to other nodes (Ibarra, 1992; Wasserman & Faust, 1994). High *out-degree* centrality indicates which actors are influential in the network, with the presence of many ties to other actors indicating the ability to distribute information quickly. High *in-degree* centrality indicates which actors may be prominent, with many ties being received by an actor

indicating that others are seeking access to that actor and often consulting him or her on a variety of matters. An actor's degree centrality also indicates that he or she has multiple ways and many resources to reach goals. This measure is different from *centralization*, a measure of the entire network indicating the extent to which a network revolves around a single node.

Centrality may give insight into the significance of specific actors within the context of a team network. For example, Balkundi and Harrison (2006) found that when analyzing the results of 37 studies, leader centrality in a team's instrumental network was positively associated with task performance and resource advantages for the team. Past scholarship has also explored leader centrality specifically in the engineering design context, finding that leadership position in engineering design teams has a significant impact on team creativity and team interactions (Kratzer, Leenders, & VanEngelen, 2010). The latter study found that a leader's centrality in different types of communication networks differently impacted team creativity, where high centrality in the work-flow and awareness networks diminished creativity, which is instead propelled when leaders take more peripheral positions in these networks. Indeed, the effectiveness of individuals in formal leadership roles may be more influenced by the informal social relations and team processes that can undermine or reinforce a leader's position (Baker, 1990). Sparrowe et al., (2001) found that individual job performance was related to centrality in different kinds of team networks. Centrality measures have also been linked to information sharing and seeking in organizations. Borgatti and Cross (2003) examined the reasons behind some information-seeking behaviors in organizations, finding that individuals may decide to seek information from someone based on "(1) knowing what

that person knows; (2) valuing what that person knows; and (3) being able to gain timely access to that person's thinking" (p. 432). Not only must a person know to what information another person has access, but they must also value that information and have easy enough access to that person to make the information-seeking reasonably easy. Such studies illustrate the importance of centrality to team performance and outcomes. In particular, I highlight the effect on team processes like creativity and performance, suggesting that centrality of team members can have an important effect on individual perceptions and team processes that are inherent in design work.

I examined individual network positions to explore whether certain individuals in the project teams have more significance in specific relational contexts, and to explore how and why certain individuals become more or less central in networks assessing different types of competence in these design teams. To do this, I assessed measures of centrality across the different relational matrices. Actors who are in strategic locations within the network are in positions of influence within the network, with the ability to quickly and effectively distribute information to others; they may be more prominent; or they may have more power in the network. Additionally, qualitative data provided insight into how and why those individuals were seen as prominent or influential in the different areas of design-related work. An in-depth discussion of the constructs I chose to measure is offered in Chapter 3.

An additional measure of importance to this study is network centralization. Centralization refers to the extent to which interactions within the network are centered around one or a few individual actors, rather than being more evenly spread among all actors in the network (Wasserman & Faust, 1994). A high proportion of centralization

may indicate that one or a few individuals on the team are more influential or prominent in that network, having a greater number of ties than other individuals in the network.

SNA offers an important perspective on the team process by showing how team members *actually* relate to one another. I used these analyses to uncover how team members may be more or less influential in different kinds of networks within the context of design work, as well as how team relations emerge surrounding ethical, technical, and program competence in these teams, and which team members are influential in which contexts. Relational concerns can have a major impact on how people work together, collaborate, and solve problems. These measures helped me to visualize the patterns of interaction that may affect the discussion and team processes at a micro level, by showing a detailed account of the role each member plays communicatively in the team as well as the overall network structures that emerge in these teams.

Throughout the past literature on teams and network structures, it has become apparent that network structures do matter in terms of team performance (see Balkundi & Harrison, 2006). However, it is not yet known *how* team network structures specifically relate to ethical processes within teams. This study intends to probe that relationship, to explore what factors of team network structures may be related to team ethical performance, including discussion (*during* the team process) and output (the end result).

2.7 Research Questions

This project focuses on two overarching goals: (a) exploring team members' descriptions of their experiences in these teams as they produce or constitute the nature, meaning, and outcomes of ethics in student project design teams, and (b) investigating structures that emerge as design teams shape and are shaped by ethical decision-making

relations. Drawing on the above theories and grounded in a social constructionist approach, this project is guided by the following research questions:

RQ1: What are the structures that emerge around technical, program, friendship, and ethical relations in student multidisciplinary engineering design teams?

RQ2: How are technical, program, friendship, and ethical relations communicatively constituted in these teams?

RQ3: How is "everyday ethics" communicatively constituted in multidisciplinary engineering design teams?

In the next section, I discuss the methodological approaches that enable me to address each of these questions.

CHAPTER 3. METHODS

3.1 Introduction

Because of the fluidity of the concept of ethics and the dynamic process of teamwork and design work, this project employs two primary procedures for gathering data: semi-structured interviews and a survey instrument to assess social networks. Given the contested and elusive nature of ethics in design described in the previous chapter, I employed an overall constitutive approach that enabled me to utilize a social network analysis to visualize the relations at the full class level that emerged around ethics and other central constructs in these teams, as well as to conduct interviews to probe the students' perspectives and discursive constructions regarding ethics.

Qualitative data were analyzed using a discursive psychological approach; quantitative data were analyzed through UCINET 6.5 (Borgatti, Everett, & Freeman, 2002). This chapter begins with a description of the participants and recruitment strategies, then discusses the three phases of this project, beginning with some methodological considerations for each phase, data collection procedures, and a discussion of analytic techniques.

This study employs a mixed methodological approach in order to provide a comprehensive understanding of issues probed in the research questions guiding this project, with emphasis on a qualitative approach to the study of project teams. Although

many existing group research studies favor an experimental or quasi-experimental design, my approach is in keeping with another line of scholars' claims that a qualitative approach affords the researcher more detailed, insightful analysis with the ability to link meaningful patterns displayed in practice (Jung et al., 2009; Morty & Morey, 1994; Yauch & Studel, 2003). The fluidity of the nature of ethics and the complexity of studying team communication and processes necessitates such a rich approach. Indeed, in trying to explore idea sharing and creativity in team networks, Sullivan, Pierce, Leonardi, and Contractor (2013) acknowledge the constraints in methodology when trying to manipulate teams and instead offer a simulation model to help explain and examine these issues. The current project extends their effort into a naturalistic setting, where real teams in real design tasks are observed and examined. Thus, this study employs in-depth semi-structured interviews as well as an analysis of team social networks. An overall qualitative design lets me explore how team members perceive, experience, and understand ethics (the "everyday ethics") of design; while the Social Network Analysis (SNA) component of the study lets me explore team structural characteristics and their impact on those perceptions and the team's overall discussions and decision-making.

One strength of utilizing a mixed methods approach is that it enables me to draw from and utilize different metatheoretical perspectives in such a way that they both complement one another and challenge one another, with the intent that both methods and the overall findings of this study are enriched. This intent is in contrast to a multi-method study (Creswell, 2003), in which the separate methods that are employed are distinct and do not "talk to each other."

3.2 Research Design

In order to explore the research questions guiding this project, a mixed methods approach is the most appropriate because it allows for both collection and analysis of data on multiple levels. This section discusses the methods and analytic techniques I employ in conducting this project: a social network analysis of 7 student design teams (Part 1); a discourse analysis of semi-structured interviews with team members (Part 2); and integration of the findings of these two approaches (Part 3). In taking a constitutive approach to engineering ethics, the overall goals of this project focus on ethics in design--how teams and their members discursively construct the meanings and significance of ethics, and structure relations—while engaging in the design process.

The overarching goal of this study is to explore how ethics is communicatively constructed in multidisciplinary project teams in an engineering education context, and how ethical decision-making emerges during team members' descriptions of team interactions and becomes integrated in design specifications and solutions.

3.2.1 Participants and Recruitment Strategies

This study presents findings from two classes comprised of 7 project teams of multidisciplinary students in an engineering education program situated within the EPICS Program at Purdue University. This program is a multi-disciplinary service-learning design course that emphasizes a human-centered design model. Student teams of undergraduates partner with local or global not-for-profit community organizations to define, design, build, test, deploy, and support engineering-centered projects that aim to significantly improve the organization's ability to serve the community. In EPICS, there are larger teams that represent the class division, and within those classes are project

teams that share a common design goal. Often project teams work on separate aspects of a similar project, ranging from sharing the same project partner to working on specialized components of the same product.

Students can participate one or multiple semesters, and the projects often last for several semesters, and occasionally, years. Teams typically have a mix of returning and new students. Students take on different team-level and project team-level formal roles for which they can volunteer or be appointed. Team-level roles include Project Manager, the overall leader of the team; Webmaster, the website content manager for the overall team; and Financial Officer, the budget and funds manager for the overall team. Project team level roles include Design Lead, the manager of the respective project team; Project Partner Liaison, the main point of contact between the project team and project partner, and Project Archivist, the manager of documentation for each semester of a project. Students can also work as a team member and contribute in a variety of ways. The two classes presented in this study varied in their composition: Class A included 25 individuals and was broken into five distinct project teams, while Class B included 19 individuals and divided into only two project teams. In Class B, the project teams split themselves into two sub-teams each. The participants for this study varied in year, major, and length of time with the program and with each specific project (see Table 1). These demographics were collected to help explain the roles and interactions that developed within this team. To protect confidentiality, pseudonyms were given to each participant. To assist in the analysis and visual representation of team relations, members of each project team were given the same initials and last name.

To maximize the use of social network analysis, I selected seven project teams within two separate classes each semester to follow that would consist of 44 individuals total. I originally selected 5 teams out of 34 total in the EPICS program, based on my availability, and the willingness of the advisor to allow me to observe the class. I observed 4 of them during the first week of the semester, after disqualifying one team on which a member of my dissertation committee became an advisor. This disqualification was necessary in order to comply with my IRB regulations, which mandated that no one associated with the research be directly involved with my specific participants. While the position of two of my committee members as co-directors of the EPICS program was deemed acceptable, as long as they were not given access to data before de-identification, a direct advisor role may have pressured the students into feeling they had no choice but to participate in my study. I chose the final two teams based on two main qualifications: because of their size, both including 15 or more individuals, which would aid the social network component of the study; and the diversity of the students with regard to disciplinary affiliation, gender, and class standing, which I sought to maximize in order to better reflect the diversity associated with the field of engineering. This was an important consideration, given the highly social nature of design (Bucciarelli, 2010) that requires interaction and collaboration with diverse groups of people (NAE, 2011). While this is not a large number of participants for SNA, this enabled me to examine relations within the specific project teams, as well as how project teams interact with others in the same class.

In order to gain context, build rapport with the participants, and encourage participation in the study, I attended every lab meeting over the semester for both classes.

These observations provided me with the opportunity to take extensive notes and make observations about how the teams interacted and talked in practice, which in turn aided me in probing and follow-up questions during the interviews. These observations also supplemented my analysis and provided some insights about the types of interactions that emerged from the data.

Table 1. Demographic and role breakdown of classes*

TM Pseudonym	Formal Role	Year in school	Semesters with program	Major	TM Pseudonym	Formal Role	Year in school	Semesters with program	Major
Class A									
Aaron Abrams	TM	Sophomore	3	ME	Henry Hanes	TM	Sophomore	2	ChmE
Abbey Abrams	DL, Team 1	Senior	4	ME	Qayanat Quenton	TM	Freshman	1	ME
Adele Abrams	TM	Junior	5	ME	Quincy Quenton	DL, Team 4	Junior	4	EE
Adi Abrams	TM	Sophomore	3	ME	Quinn Quenton	TM	Junior	1	IDE
Anderson Abrams	TM	Sophomore	3	EE	Zach Zanes	TM	Junior	1	ME
Annie Abrams	TM	Junior	3	ME	Zander Zanes	TM	Sophomore	1	EE
Danielle Dougherty	PM	Senior	7	ME	Ziyu Zanes	TM	Senior	1	ME
Danny Dougherty	DL, Team 2	Junior	4	EE	Zoe Zanes	DL, Team 5	Junior	5	MDE
Daren Dougherty	TM	Graduate Student	1	IE	Erinn Eubam	TA	Graduate Student	6	BME
Dennis	WM	Senior	3	NE	Ertie Ebaum	TA	Graduate	1	EE

Dougherty							Student		
Diane Dougherty	TM	Freshman	1	BME	Dr. Kyle Kastan	Advisor	N/A	9	ME & BME
Harrison Hanes	TM	Sophomore	2	ME	Kristopher Kennington	Advisor	N/A	2	BME
Heather Hanes	DL, Team 3; FO	Senior	2	ME					
Class B									
Rachel Rogers	WM	Freshman	1	ChmE	Rosa Rogers	PA, Team 2	Junior	1	NB&P
Sam Sander	SD Team, Team 1	Senior	1	CmpE	Steven Sander	PPL, Team 1	Senior	3	MATH
Ryan Rogers	TM	Freshman	1	ME	Sebastian Sander	DL, Team 1	Freshman	1	AAE
Saul Sander	PM	Senior	4	ETTE	Sara Sander	WM	Freshman	1	FYE
Raquel Rogers	PPL, Team 2	Sophomore	3	EE	Reid Rogers	DL, Team 2	Freshman	1	FYE
Ray Rogers	TM	Freshman	1	FYE	Kevin Kowler	Advisor	N/A	1	EDU
Shou Sander	PA	Freshman	1	FYE	Krista Krenchie	Advisor	N/A	3	EDU
Russel Rogers	TM	Senior	2	ETTE	Dr. Kurt Kranks	Advisor	N/A	11	ENE
Shawn Sander	SD Team, Team 1	Senior	1	CmpE	Eshni	TA	Graduate Student	2	EE & CmpE
Shayna Sander	FO	Freshman	1	UND					

*DL=Design Lead, FO=Financial Officer, PA=Project Archivist, PM=Project Manager, PPL= Project Partner Liaison, TA=Teaching Assistant, TM=Team Member, SD=Senior Design, WM= Webmaster; ME=Mechanical Engineering; BME=Biomedical Engineering; EE=Electrical Engineering; CmpE=Computer Engineering; FYE= First Year Engineering; ChmE=Chemical Engineering; AAE=Aerospace Engineering; ENE=Engineering Education; ETTE=Engr Tech Teacher Ed; NB&P= Neurobiology & Physiology; I/MDE=Inter/Multi-disciplinary; IE=Industrial Engineering; NE=Nuclear Engineering EDU=Education UND=Undecided MATH=Mathematics

3.2.2 Part 1: Social Network Analysis

The first part of this project examined the patterns of communication and relations that existed within these teams using social network analysis techniques (Wasserman & Faust, 1994). This analysis enabled me to examine how team members perceived their relations to one another, and how team member roles developed and potentially influenced ethical considerations in the projects.

3.2.2.1 Methodological Considerations

By employing a social network analysis approach informed by structuration, I was able to examine "how microdecisions affect the emergence of a macrostructure and how this macrostructure feeds back and influences subsequent [individual] behavior" (Whitbred et al., 2011, p. 407). I examined the two levels of social network measurements, those that describe the network as a whole (network density) and those that give information about the participation of individual actors in the network (degree centrality). I then consider these findings in relation to how network structure may relate to ethical team processes.

3.2.2.2 Procedures

The SNA was conducted by administering a survey (for full survey, see Appendix C) to every member of the classes which house multiple project teams (classes ranged from 19-25 people, which cluster into smaller project teams ranging from 4 to 9 members). This survey was developed based on previous literature on ethical work climates (Arnaud, 2010) as well as literature probing the role of trust in social networks

(Chua et al., 2008). I sought to assess different aspects of design and the relations associated with it. My initial questions included on the survey were as follows:

> **Q1.** Using the grid below, please check off names of people who **you work with most regularly** (e.g., every class meeting; sometimes outside of class time).
> **Q2.** Check off the names of the people below who you would say are **part of your project team** (the smaller team unit you work in within the larger class).
> **Q3.** Check off the names of the people below who you would **go to for advice** if you encountered an issue as you worked on your project over the semester.
> **Q4.** Check off the names of the people below who you would go to for advice if you felt there was an **ethical issue** as you worked on your project over the semester.
> **Q5.** Check off the names of the people below who you feel you really **trust and could confide in** about issues related to your EPICS project.
> **Q6.** Check off the names of the people below who you would consider **friends or friendly acquaintances**.

I conducted a pilot study to test the phrasing of the items, during which I administered a survey to a small EPICS team over the summer and then conducted talk-aloud interviews with the team members to assess how they interpreted the items and made revisions to the items before administering them for the data reported here. After conducting the pilot study, I revised the questions asked on the survey. I removed the question asking for members of one's project team, as that information was available to me through the class roster. I retained Q1 in order to assess who participants constructed as their central relations in their project work. The most significant change was made to the items assessing advice and ethics. The initial items were accessing a more instrumental aspect of these relations, which was not conducive to the constitutive approach. As I wanted to assess patterns of relations and trust, I adapted the new items

from Chua et al. (2008) to assess cognition-based trust, which reflects the reliability and competence associated with trust, as well as affect-based trust, which involves empathy, rapport, and self-disclosure. I also broke this question into two questions, one probing the technical side of design and one probing the programmatic context. I also adapted the ethical item to reflect a more relational, expressive approach, rather than instrumental. Finally, I removed the term "acquaintances" from the friendship item to probe a more precise and significant relation of friendship. The final items I included in the social network survey were as follows:

Q1. I work with this person regularly (e.g., every class meeting; sometimes outside of class time)

Q2. I can **rely on this person to complete a task he or she agreed to do.**

Q3. I would feel comfortable **sharing my personal problems and difficulties** with this person.

Q4. I can rely on this person to have the **technical competence** needed to get the task done.

Q5. I can rely on this person to have the **project/ EPICS knowledge** needed to get the task done (non-technical).

Q6. I would go to this person if I had a **serious ethical concern** about the project.

Q7. I consider this person a **friend**.

In keeping with Krackhardt and Hansen (1993), these items allowed me to assess the relational elements of the social interaction that took place on these teams. As I discussed in Chapter 2, past literature suggests that leaders have a significant impact on team functioning and relations. As such, I chose to include the advisors, who are industry experts or professors in various disciplines of engineering at the university, as well as the teaching assistants (TAs). These individuals represent an important resource for information and guidance to the project teams. This decision to include advisors and TAs

allowed me to assess a complete network (the class) and how the project teams within it perceived their networks of relations. The survey contained two sections: (a) a sociometric survey probing the relationships among the team members by employing a roster method, which provided a complete list of all the members of a project team and asked the participant to relate their communicative relationships with them (Wasserman & Faust, 1994) and (b) a short questionnaire, which requested relevant demographic information, including age, gender, ethnic/race category, perceived role in the group, and other important factors.

Due to time constraints, data collection occurred once during the semester, but the interview and survey asked participants to discuss their experiences at the start of the semester and at the end of the semester to reflect on the entire process and provide insight into how the network structure emerged and how participants perceived it shifting over the course of team interactions.

3.2.2.3 Analysis

As my goal was not to conduct an independent social network analysis of these teams with the intent of explaining and predicting team structures, I analyzed these data with a focus mainly on descriptive elements that enabled me to visualize the team's network structures and explore the relationship between those structures and the qualitative findings generated in Part 2. I used UCINET (Borgatti et al., 2002) to generate outputs of the SNA measures as well as the visualization element NetDraw to help me visualize and describe the networks that emerged around technical, program,

ethical, and friendship networks and explore measures of centrality and density to identify actors in the network who may be in locations of significance.

Density values were generated for each network in both classes. In order to assess the significance of these values, I compared the densities of the technical, program, ethical, and friendship networks within each class in order to examine whether they varied in significant ways. However, the small sample sizes for this study paired with the nature of the social network data make traditional statistical analytic methods more challenging, and traditional inferential statistical analytic methods are not suggested for analyzing social network data (Monge & Contractor, 2003). This recommendation not to use traditional inferential statistical analyses is because many of these analytic methods assume independence of samples and observations but, by its very nature, social network analysis deals with sets of relations that are interconnected and involve the same actors across multiple observations (Hanneman & Riddle, 2005).

A *t*-test would be an appropriate analysis to compare the densities of networks. While *t*-tests are fairly robust to violations of some of its core assumptions, such as a fairly normal distribution of scores and independent and uncorrelated samples (Warner, 2013), small sample sizes tend to present challenges. Social network scholars have developed methods for dealing with these challenges. As such, I used the bootstrap-assisted paired samples *t*-test available in UCINET developed by Snijders and Borgatti (1999) to compare the densities for these networks. First, the sample was paired because it compared the same actors in both networks for different sets of relations. The bootstrap method is used to compare the densities of two networks in which independence cannot be assumed by re-sampling with replacement many times to

generate an empirical distribution of mean differences (Warner, 2013, p. 658). This method reduces the chance for Type I error or a "false positive," which would cause the researcher to reject the null hypothesis that assumes equivalence between the two groups, incorrectly.

For this study, I focused on two measures within the social network analysis: degree centrality and network density. Network density measures the percent of ties that exist within a network compared to the total number of ties possible (Wasserman & Faust, 1994), with 0 indicating isolated actors and 1 indicating that every actor is connected to every other actor in the network.

Degree centrality refers to the number of direct ties a node has to other nodes (Ibarra, 1993; Wasserman & Faust, 1994), indicating how many people on the team evaluate that person as competent or trust them enough to seek advice on a certain topic. I computed degree centrality scores for each individual on these overall teams. I generated both in-degree measures, which indicate an actor's prominence by showing how many people included that actor in their network, and out-degree measures, which indicate an actor's influence or perceptions of others. I computed both measures because trust relations are directed, meaning that X trusting Y does not necessarily imply that Y trusts X. While in-degree measures allowed me to see how other members of the team perceive the participant, out-degree measures are limited by their self-report nature and allowed me to assess how the participant perceives him or herself in the context of the team.

Finally, I also looked at network centralization, which was calculated in UCINET using Freeman's definition (Borgatti et al., 1992). This number was calculated by first

looking at the difference between centrality scores of the most central actor and those of all other actors in the network; this calculation is used to form a ratio of the sum of the differences to the maximum sum of all the differences (Wasserman & Faust, 1994, p. 33). This measure indicates the extent to which a network revolves around one or a few actors, versus being more evenly distributed among all the actors.

These measures were examined relative to each class, representing a work group, rather than at the level of the entire organization of EPICS. The decisions listed in this section are in keeping with past research on networks in small groups (Sparrowe et al., 2001).

3.2.3 Part 2: Semi-Structured Interviews

3.2.3.1 Methodological Considerations

The second part of this project explored how ethics is constructed and handled discursively by members of multidisciplinary project teams in an engineering education context. This part has several goals: (a) to provide an interpretive framework for the first part, and complement the interpretation of those results, and (b) to provide insight into how the participants understand, handle, and interpret ethics in their experiences on their teams. I used the results of this part to articulate how ethics is discursively constructed in these project teams and consider how ethics is (or is not) interwoven into the everyday processes and interactions of each team. Through a discursive analysis of participants' responses in the interviews, I explored how the students define and understand ethics, the experiences on their teams and in the design process that may or may not have ethical implications, and what discursive resources are being commonly utilized in the

participants' talk that could indicate the ethical resources being offered by the EPICS program.

Discursive psychology scholars seek to analyze the ways psychological, material and social objects are invoked and attended in social interaction and other activities; this is the *practical* focus of discursive psychology (Potter, 2005; Potter & Edwards, 2001; Potter et al., 2001). Instead of analyzing talk and interaction as something to "see past" in order to reveal an individual's "true" beliefs and attitudes, discursive psychology locates the creation of meaning and reality *in* social interaction; individuals as social actors *actively create* reality and shape identity through their talk (Edwards, 2003). Thus, psychological states are studied for the way they are attended in talk, rather than what they reveal about the speaker (Edwards, 2003). For example, rather than analyzing an interaction to see how prejudice is revealed through the person's talk, discursive psychologists would be interested in how prejudice is attended in the talk.

Given this focus, discursive psychologists seek to analyze how a person's talk can create his or her own identity, shape the identity and position of others, and can do interactive work such as countering an undesirable image of oneself. Indeed, Potter and Edwards (2001) note Edwards and Potter's (1992) argument that claims and descriptions offered in discourse are often "designed to *counter* potential alternative versions and resist attempts (perhaps actual, perhaps potential) to disqualify them as false, partial or interested" (p. 104). Thus, scholars using a discursive psychology perspective analyze talk and interaction to see how individuals use characterizations and evaluative expressions to attribute identity and motive to others, how they counter and respecify

others' descriptions of their identity or actions, and how psychological themes are handled and managed implicitly (Edwards, 2004).

However, discursive psychology should not be cast as just a methodology; indeed, scholars have suggested that limiting this perspective to methodological areas alone is misleading and unproductive (Potter, 2003). Rather, it is an analytical approach that is embedded in social constructionist assumptions, as outlined in detail in the previous chapter. Typically, researchers using this approach draw on the method of conversation analysis to study the ways in which interpretative repertoires ("big D" Discourse) or linguistic resources surface in talk-in-interaction ("little d" discourse). Recalling the discussion in Chapter 2, interpretative repertoires are ways of talking embedded within larger societal or cultural Discourses, which supply linguistic resources to communicating actors in the form of habitual forms of argument (Wetherell, 1998), terminology, metaphor, and other language devices (Potter & Wetherell, 1987). These linguistic resources are necessary in order to form identities and shape representations of the world through talk-in-interaction.

As the goal of discursive psychology is to examine talk-in-interaction, there is a push to apply this approach to situated interaction and records of interactions in natural settings (Edwards, 2004; Potter, 2005; Potter & Edwards, 2001). However, this dissertation study focused on in-depth, open-ended interviews, which has come to be seen as geared more toward perception and understanding, rather than the actual use of discourse in everyday activities (Potter, 2005). As such, this part utilized a form of textual analysis inspired by conversation analysis and grounded in discursive psychology. This approach was well-suited for this project, in that it allowed me to focus on language

as constituting social realities, rather than language as *revealing* existing psychological states. Indeed, discourse analysis enabled me to explore the way social reality was *produced*, matching the fluid, subjective nature of ethics and the dynamic design process, throughout which ethics is constantly being negotiated and invoked, as team members collectively struggle to give it meaning and significance.

3.2.3.2 Procedures

I conducted a series of in-depth interviews that probe deeply into the team and design process. There were two sections to the interviews. The first section was a semi-structured interview with questions about team member interactions, design decisions, and considerations the participant had as well as any considerations that were raised by other team members. This section was followed by a discussion of the social network responses of each participant. The interview questions were adapted from the interview protocol used in a NSF TUES grant that produced an instrument to assess individual ethical reasoning in an engineering education context, allowing me to construct questions that access a more nuanced view of ethical decisions. Questions followed the following themes:

- asking participants to recall and describe two or three decisions their team has made thus far in the project
- asking them to describe as they see it the design process their team has followed, including asking them to chart out the choices the team has made along a timeline
- asking about team member interactions, such as who the participant would go to for advice, who speaks up most often in team discussions, what is the tone and

atmosphere of decision-making discussions, and how the participant perceives the roles and qualifications of each member of their project team

At the conclusion of the interview, participants were asked to complete the SNA survey for the second part. Whereas this survey was used for a distinct analysis, it was reviewed and discussed during the interviews to provide more insight into how and why participants selected different team members for different networks.

Because social network analysis requires a high response rate (Wasserman & Faust, 1994), I offered cash incentives to participants and obtained responses from 43 of the 44 participants. I conducted interviews with 22 or the 25 members of Class A and 15 of the 19 member of Class B. Interviews ranged from 28:04 to 1:11:49, averaging 52:47. Interviews were audio recorded to allow me to listen attentively and ask relevant follow-up questions to probe the participants' experiences. I took limited notes during the interviews to note areas of specific interest and assist in developing follow-up questions. After each interview, I recorded a brief research memo to summarize ideas and thoughts from the interview. All interviews were transcribed and de-identified in order to protect the confidentiality of the participants, with the raw data being stored in an encrypted file. Each participant, along with any team members they may have mentioned over the course of the interview, was given a pseudonym. Any identifying information about the program, project, or participant was masked or altered accordingly.

3.2.3.3 Analysis

Qualitative data were transcribed and analyzed using discursive analysis grounded in a discursive psychological approach (Potter & Wetherell, 1987; Wetherell, 1998).

This approach allowed analysis to focus not on how ethics is *revealed* or hinted at through the interviews, but rather how it is *communicatively constituted* (Fairhurst & Putnam, 2004; McPhee & Zaug, 2000) and discursively handled (Edwards, 2003; Potter, 2005; Wetherell, 1988).

Participants' responses to these interview questions were transcribed to generate the text of the interviews. Although a discursive psychological approach offers specific procedures for text examination, it is important to note that discursive psychology is not in itself a methodology. Rather, it is an analytical approach that is embedded in social constructionist assumptions, as discussed above. As such, I focused on the text of these interviews to investigate ethics and how it is invoked throughout the engineering design process.

To conduct this analysis, I conducted coding through the use of Atlas.ti qualitative coding software. I developed a coding scheme (for a complete list of codes, see Appendix E) based off team and ethical reasoning literature. These codes were intended to capture utterances related to team processes, such as interdependence, conflict, and socialization of new members, as well as ethical reasoning, such as moral intensity, design priorities, and definitions of design. Examples of these codes included: "Interdependence- design," "Interdependence- team work," "Team norms," and "Leadership influence." I added or removed codes as I conducted my initial pass at analysis, generating several new codes that emerged from the data as important, such as: "Understanding of design," "Constructions of competence," and the three design priorities of desirability, viability, and feasibility.

In keeping with the spirit of discursive psychology, I approached my analysis on two levels: examining the "little d" discursive practices used by individuals to see how they handled and managed certain concepts, and looking for evidence of the "big D" interpretative repertoires that emerged as common lines of reasoning, metaphors, phrases, and other linguistic and conceptual markers that suggested the discursive resources upon which all the students were drawing.

While I developed my interview protocol to probe for ethical considerations in students' design work, I also knew, based on the extensive literature, that ethics is a complex, fluid, and often unnoticed phenomenon in this context (Lloyd & Busby, 2003; van de Poel & Verbeek, 2006). As such, I examined the text of the students' interviews first to see how they explicitly discussed ethics, which was asked about at three different points throughout the interview with the questions: "What does ethics mean to you?" "Does ethics affect design work?" and "What ethical issues did your team face?" Then, I examined the participants' talk for more implicit impressions about ethics. Specifically, I examined students' factual descriptions, instances of countering (which often took the form of discouraging me to view them as "unethical"), and other discursive practices (Potter & Edwards, 2001) to look at the way they constructed their and their team mates' motives, intentions, and orientations toward design that may have hinted at an ethical orientation. I examined not only what they said explicitly *should* be done by an "ethical engineer" or a student in EPICS, but also what they constructed as their orientations toward ethics—implicit and explicit—through their descriptions of their considerations, the values they appealed to when describing to me those decisions and thought processes, their retelling of how certain decisions were made and their own and their team mates'

contributions to those decisions, and their talk about discussions and reasoning throughout their project experience. These specific analyses allowed me to delve into not only how students explicitly define and position ethics within an engineering education design context, but also to see how they constructed and discursively managed the role, importance, and value of ethical orientations in their project teams.

In conducting the second level of "big D" analysis, I looked not only at the students' descriptions individually, but at the whole picture of their collective responses and their collective discursive practices to identify commonalities in the way they justified and described different elements of their experiences. To accomplish this portion of the analysis, I looked for evidence of the interpretative repertoire offered by various Discourses in the form of familiar arguments, terminology, metaphors, themes, imagery, and various linguistic devices, and analyzed the way in which the participants drew upon them in order to describe, explain, or justify their statements and descriptions of both their personal identity, their identity as an engineer and member of their team, and their engagement with their particular project, as well as their descriptions of their interactions and specific decisions made along the way.

For example, it would not be uncommon to find a Student Discourse in an engineering education context, which might be marked by appeals to motives around grades, developing necessary technical skills for future employment, or other concerns that might be commonly available to individuals embedded in a higher educational context. By identifying evidence of "big D" interpretative repertoires that were shaping and being appealed to in individual responses, I was able to identify and name some of the discursive resources that seemed to be available to all of the participants. This

portion of the analysis aided me in being able to describe not only how individual team members discursively approached ethics in these teams, but also the common resources that all members were able to use when trying to make sense of and talk about their experiences and the place of ethics.

Finally, I examined the interplay of these two levels of discourse to begin to describe how the discursive resources that were available and the discursive practices each student used to construct his or her notion of the role of ethics in their teams reflexively shaped and constituted one another. That is, I explored how students drew from the "big D" interpretative repertoires to shape their descriptions, appeals, and motives that characterized their specific discursive practices, as well as how those discursive practices when taken together constituted their group-level orientation toward ethics and design.

3.2.4 Part 3: Synthesis of Analyses

After analysis of both initial parts was completed, results were synthesized and considered in conjunction with one another in order to explore the concepts that guide this project: the communicative construction and handling of "everyday ethics" in team-based project design work, and the reciprocal influence of team structures and ethical perspectives in design. Specifically, I considered the major themes that emerged in the discursive analysis in light of the SNA findings, to see if any elements of the social network measures of density and centrality could help illuminate the qualitative findings and vice versa. This was a particularly useful step of the analysis given that the social network data asked about specific sets of relations, and the interview protocol included an explicit discussion about how students decided who to include and who not to include for

each of the particular networks. The discursive practices of countering, factual descriptions, and moves to include or exclude individuals from one's conceptualization of the project team were particularly important in assessing how students made these judgments and what they meant to the individual participant. This approach allowed me to conduct a type of member checking, which lent validity to the social network findings, as well as providing specific insights into how these relations were perceived and handled by students on these teams.

I gained further insight into the development and perceptions of these relations by pairing these findings with insights that came out of the interview method. These data interacted in two distinct ways: first, in discussing the social network results with the participants, students provided insights into how and why different team members were included or excluded from the different networks, and provided context for those decisions within a design environment. This approach enabled me to gain insight into individual discursive practices and perspectives, as well as compare across the entire sample to uncover some common ways these students were thinking about and assessing one another's competencies. Second, considered the social network findings in the context of the themes and results generated by the discourse analysis of each individual's complete interview. This allowed me to develop a clearer picture of both the informal patterns of relations that emerged surrounding technical, program, friendship, and ethical relations in project-based student design teams, as well as suggesting some of the reasons these informal patterns developed.

These analytic approaches provided insight into what students saw as salient in relation to ethics within the team process. These findings not only added depth to the

current understanding of ethics in multidisciplinary project teams in an engineering education context, but also have practical utility in helping communication scholars and engineering educators to better understand, address and ultimately encourage individual and team ethical development in work teams and in student ethical development. A detailed discussion of the results of each part, as well as consideration of these factors as they relate to answering each of the four research questions guiding this study, follow in the next chapter.

CHAPTER 4. RESULTS

4.1 Introduction

In this chapter, I present the findings that emerged from my examination of the three research questions that guide this dissertation project. These findings elucidate how members of these teams viewed each other as different kinds of resources, as well as how different kinds of knowledge and recourses are valued on these teams. I began by using a social network approach to explore my first research question (RQ1), which probed the structures that emerged around technical, program, friendship, and ethical relations in these teams. I found that the technical and program networks in Class A were statistically different from the ethical network.

Second, I conducted a qualitative discourse analysis to examine my second research question (RQ2), which asked how those four constructs—technical, program, friendship, and ethical relations--were communicatively constituted through the talk of team members. I found that students articulated distinct conceptualizations of technical, program, friendship, and ethical relations in their teams. Students appealed to different justifications for their characterization of team members as technically, programmatically, or ethically competent. While they were able to offer ample evidence and justifications for describing a team member as technically or programmatically competent, ethical competence often proved difficult for students to articulate and justify. Additionally,

students struggled to describe the role and importance of ethical competence in their teams.

Finally, I used a discursive approach to answer my last research question (RQ3), which asked how "everyday ethics" was communicatively constituted in both the talk and informal patterns of relations that emerged on these teams. While their explicit talk about ethics suggested that students did not recognize or understand it, analysis of their discursive practices throughout their descriptions of their experiences on these teams showed a human-centered orientation toward design that inherently directed them toward ethical considerations.

By presenting my findings in these three stages, I was able to present and discuss the findings of each of the two methodologies I employed in this study, and then to integrate the two to provide robust interpretation of these data. I argue that my constitutive approach, which pulls from both social network and discourse approaches, is appropriate for exploring the murky and highly subjective issue of ethics in design project teams.

4.2 Structural Exploration of Design Work

I began with a social network analysis to examine my first research question (RQ1), which asked: What are the structures that emerge around technical, program, friendship, and ethical relations in student multidisciplinary engineering design teams? This analysis explored the differences and similarities among the density and centrality measures of the technical, program, ethical, and friendship networks of both classes. The goal of this research question was to probe the characteristics of the informal patterns of relations that emerged around these four concepts, which I contend are central to design

work. The measures were chosen based on past literature that suggested density and centrality are connected to team and individual outcomes, and are appropriate to probe the relationship between team-level and individual constructions of design work.

These findings provided insight into how roles emerged within these teams, as well as the different roles in the informal social networks within these teams. The patterns of relations that emerged for the technical, program, friendship, and ethical networks of each class offered insight into how these four concepts may be viewed in these teams, and showed how certain team members were considered by the teams to be more or less involved in the manifestation of these four concepts within the team social process. Recalling Whitbred et al.'s (2011) structuration-based social network approach that guided this analysis, these measures allowed me to envision how different team members' knowledge and contribution was valued distinctly, as well as how different team members emerged as primary resources (or, in structuration terms, guides to help team members identify and follow the "rules" embedded within the structure) for these different relations and concepts related to design work.

4.2.1 Network Density

Density values were generated for each network in both classes. In order to assess the significance of these values, I compared the densities of the technical, program, and friendship networks to the ethical networks within each class in order to examine whether they varied in significant ways. I applied Snijders and Borgatti's (1999) bootstrap-assisted paired samples *t*-test to the technical, program, and friendship network densities for each class to compare them to each respective ethical network densities. The results for these comparisons are show in the table below.

Table 2: Bootstrap-assisted paired samples *t*-test

Class A: Technical to ethical

	Class A technical network	**Class A ethical network**	**Difference**
Density	0.4017	0.2267	0.1750
Bootstrap SE (5000 samples)	0.0575	0.0496	0.0760
***t*-statistic**			2.3037
Significance			< 0.05

Note: ** Significant at 5%

Class A: Program to ethical

	Class A program network	**Class A ethical network**	**Difference**
Density	0.4017	0.2267	0.1750
Bootstrap SE (5000 samples)	0.0561	0.0499	0.0751
***t*-statistic**			2.3304
Significance			< 0.05

Class A: Friendship to ethical

	Class A friendship network	**Class A ethical network**	**Difference**
Density	0.1467	0.2267	-0.0800
Bootstrap SE (5000 samples)	0.0335	0.0509	0.0610
***t*-statistic**			-1.3117
Significance			> 0.05

Class B: Technical to ethical

	Class B technical network	**Class B ethical network**	**Difference**
Density	0.3567	0.3246	0.0322
Bootstrap SE (5000 samples)	0.0515	0.0558	0.0759
***t*-statistic**			0.4239
Significance			> 0.05

Class B: Program to ethical

	Class B program network	**Class B ethical network**	**Difference**
Density	0.3860	0.3246	0.0614
Bootstrap SE (5000 samples)	0.0537	0.0569	0.0783
***t*-statistic**			0.7844
Significance			> 0.05

Class B: Friendship to ethical

	Class B friendship network	**Class B ethical network**	**Difference**
Density	0.2105	0.3246	-0.1140
Bootstrap SE (5000 samples)	0.0443	0.0564	0.0717
***t*-statistic**			-1.5904
Significance			> 0.05

The networks that differed in a statistically significant way were the technical and program networks when compared, respectively, to the ethical network for Class A. This indicates that the densities for these networks are different enough that it is reasonable to conclude these differences do not occur by random chance. This finding indicates that in Class A, the team members' network of relations regarding ethics was significantly lower than their relations surrounding technical and program competence. The density of the technical network for Class A was 0.402, indicating that about 40% of the team members reported interacting with others in the team about technical issues. Density for the program network was 0.402, identical to the technical network. The ethical network was somewhat less dense at 0.227, indicating that a smaller number (~23%) of participants felt comfortable seeking each other out for ethical concerns. In Class B, the technical network density was also somewhat low at 0.375. The program network density was 0.386. The ethical network came in at 0.325. While there were slight distinctions, the networks were very similar and differed less than the networks for Class A. In both classes, the technical network was marginally more dense than the ethical network, suggesting that participants reported interacting more surrounding technical trust than ethical. While the differences in density across the networks in Class B were not dramatically different, the subtle distinctions between these networks in both classes suggests that these concepts may be viewed somewhat differently by team members.

The differences in densities for these networks suggests that at the full team level, relations between team members surrounding technical, program, and ethical competence may manifest distinctly. Lower densities suggest that fewer team members in a given

network identified other team members for that particular network, indicating that the team as a whole may consider fewer people as technical, program, or ethical resources for their projects. While highly dense interpersonal ties in a team may relate to teams being better able to attain their goals and stay together (Balkundi & Harrison, 2006), high density has also been linked to more member conformity (Krackhardt, 1999). Density can also have implications for information-sharing in teams (Sparrowe et al., 2001). The densities for these particular team networks suggest that students in these teams are seeing each other as technical and programmatic resources, but somewhat less as ethical resources for their projects. While only Class A showed statistically significant densities in the technical, program, and ethical networks, the trend of lower densities in both teams for the ethical networks suggest that ethics is a somewhat less commonly identified resource in these teams. This finding was probed and further elucidated by the discourse analysis discussed in the next section of this chapter.

4.2.2 Network Centralization

Examination of network centralization, or the variability in degree centrality of all the actors in the network, also revealed qualities of these networks that may be of interest in considering team members' engagement in ethical design work. In Class A, the technical, program, and ethical networks were centralized with proportions of 0.6233, 0.537, and 0.6753, respectively. The higher centralization indicates the presence of a small number of actors with much higher centrality scores than the rest, meaning that a few actors in the team are the most prominent and influential regarding technical or ethical issues. The networks in Class B were less centralized, with proportions of 0.3272, 0.296, and 0.4198 respectively. This slightly lower centralization indicates that actor

centrality is more evenly distributed in this class, suggesting that team members did not identify only a few actors who were more prominent in these networks, but rather these scores were more similar. The sociograms provide a visual illustration of the differences in these networks and yielded some insights into the different interaction structures that emerged for each network. The more centralized distribution of the networks for Class A is evidenced by the presence of a smaller number of larger nodes, representing higher degree centrality, in Figures 2, 4, and 6. The lower centralization of Class B's networks are evident in comparison, with the more similarly sized nodes seen in Figures 3, 5, and 7.

The higher density and centralization for Class A's networks indicated that a small number of individuals were identified by their team members as competent in the four areas, with the ethical network being slightly more dominated by the few highly central actors. Class B's less centralized networks indicate that they are less dominated by just a few actors, and degree centrality is more evenly distributed. Again, the ethical network was slightly more centralized than the technical and program networks. This suggests that although to a small degree, the ethical network is more reliant on a smaller number of actors when compared to the other two networks.

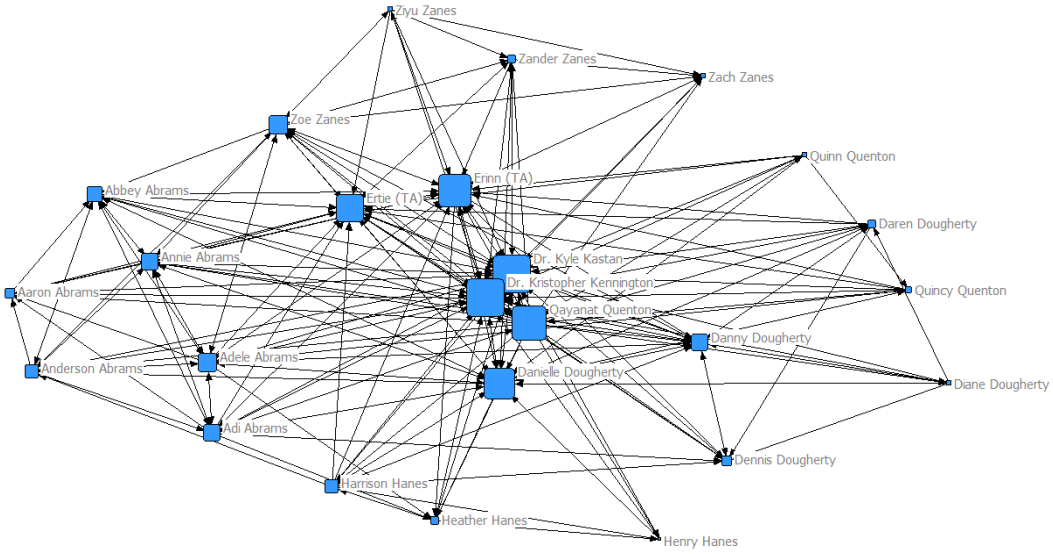

Figure 2: Sociogram of the informal relationships that emerged around technical relations for Class A

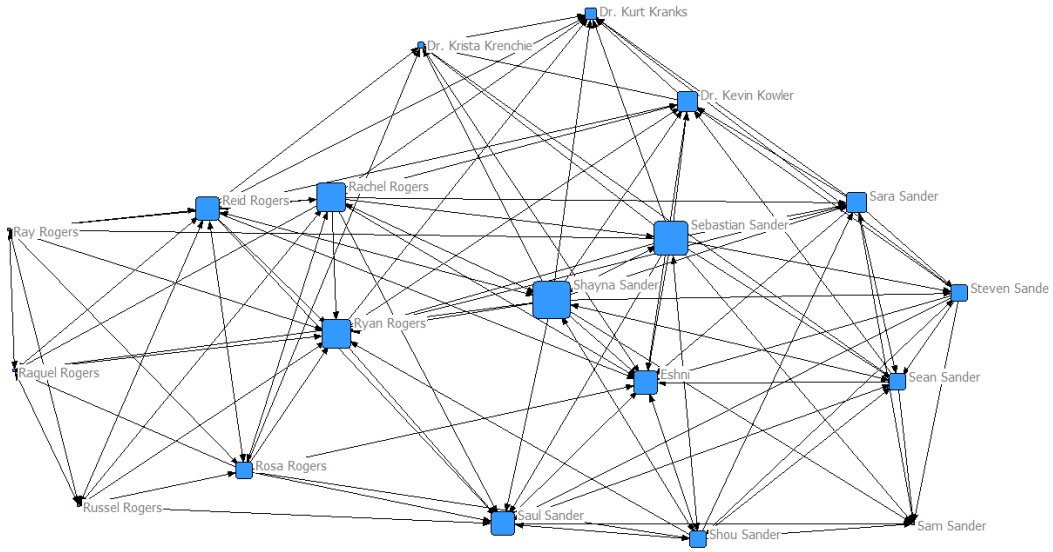

Figure 3: Sociogram of the informal relationships that emerged around technical relations for Class B

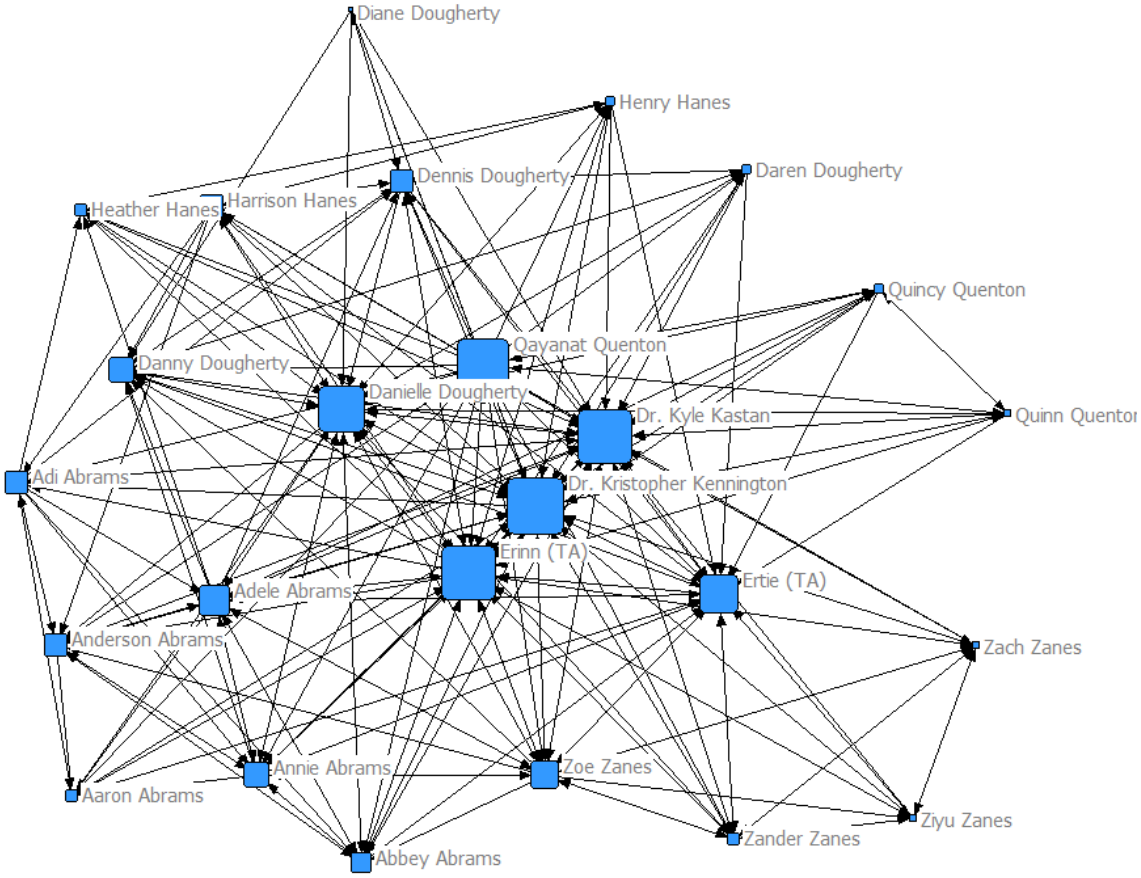

Figure 4: Sociogram of the informal relationships that emerged around program relations for Class A.

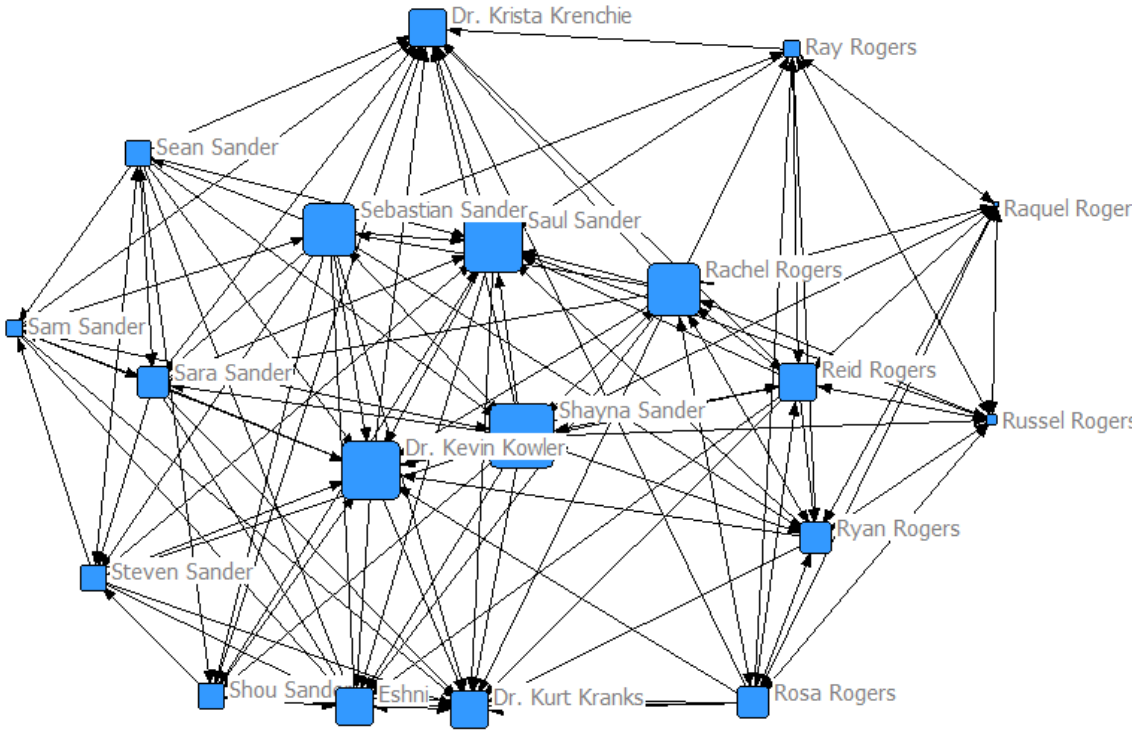

Figure 5: Sociogram of the informal relationships that emerged around program relations for Class B.

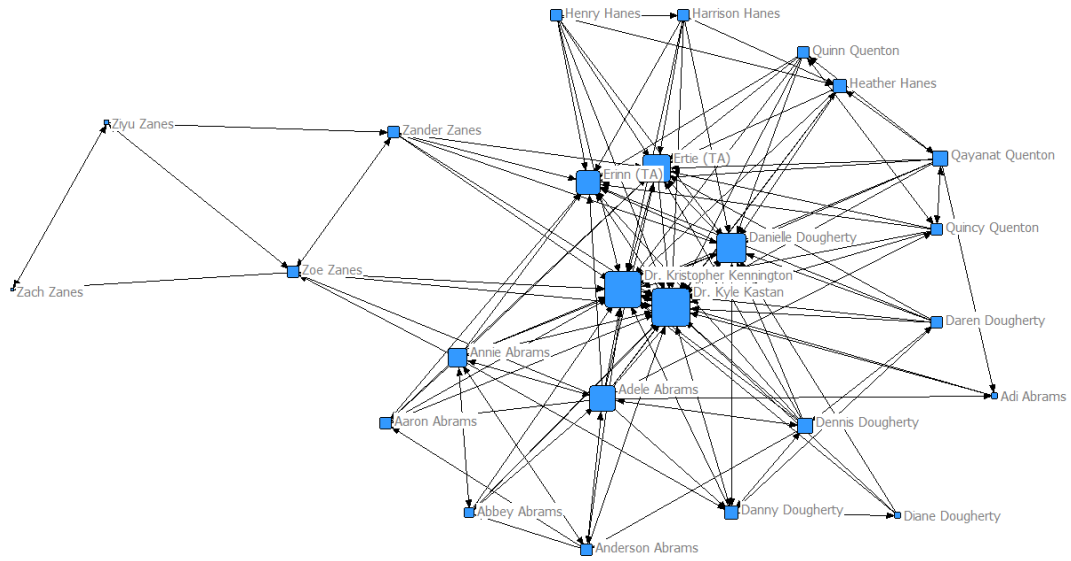

Figure 6: Sociogram of the informal relationships that emerged around ethical relations for Class A.

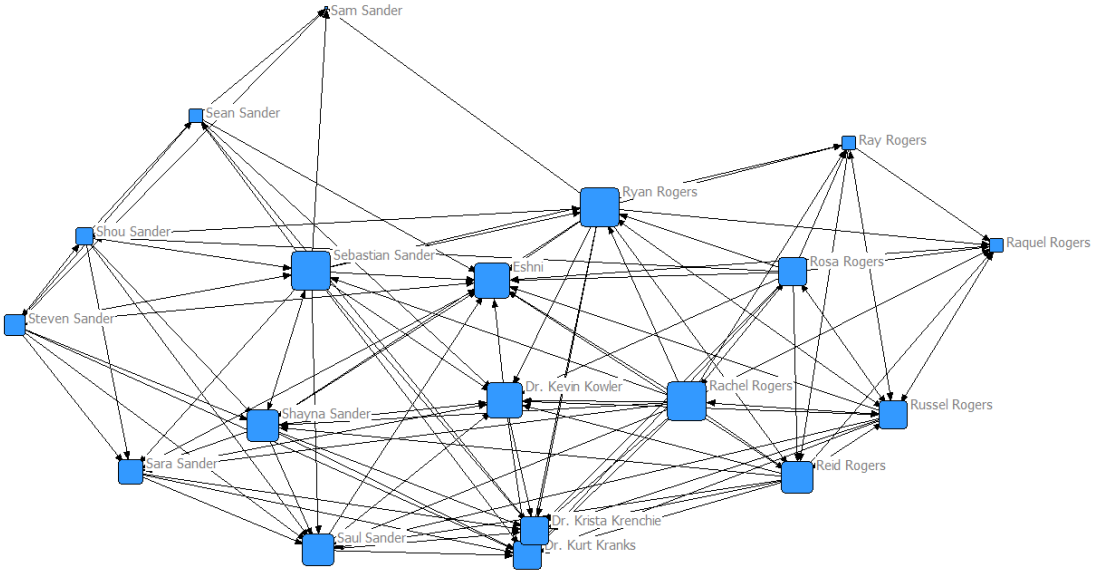

Figure 7: Sociogram of the informal relationships that emerged around ethical relations for Class B

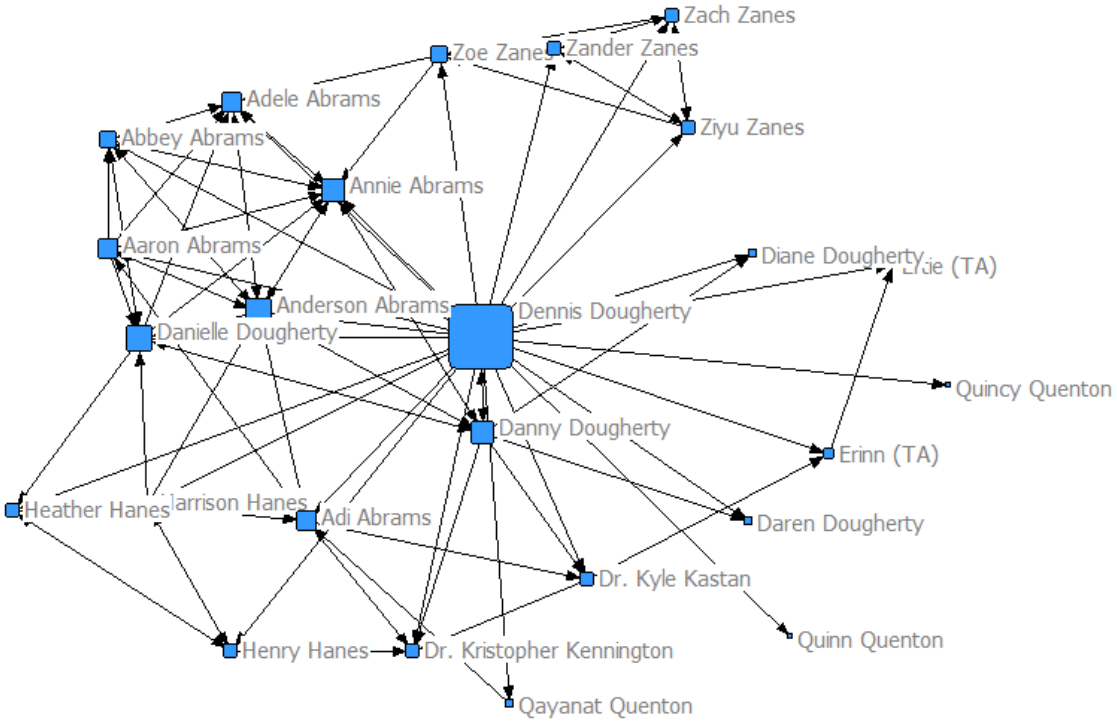

Figure 8: Sociogram of the informal relationships that emerged around friendship for Class A.

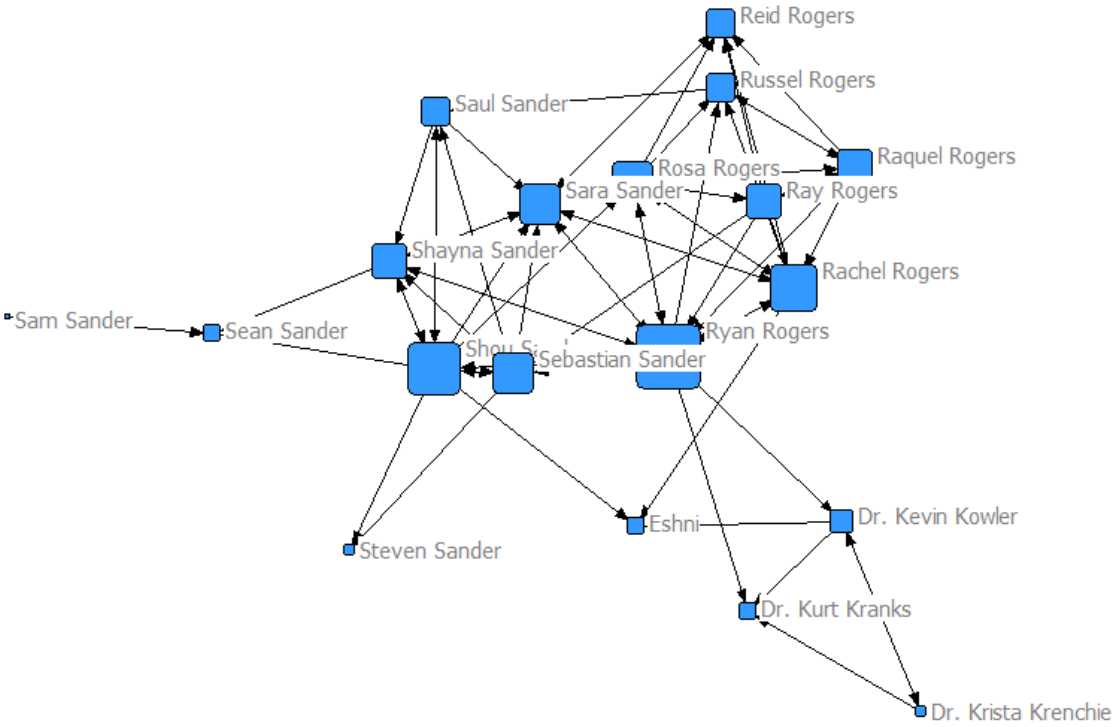

Figure 9: Sociogram of the informal relationships that emerged around friendship for Class B.

4.2.3 Degree Centrality

Examination of individual positions within each network also yielded insights. Degree centrality indicates which actors are more prominent and influential in a network, with high in-degree centrality often suggesting an actor is prominent in a network with many other members of the network consulting or considering him or her important across different considerations (Ibarra & Andrews, 1993). High out-degree centrality suggests which actors may be able to distribute information quickly through the network. I focused primarily on in-degree centrality, which for this study suggests the trustworthiness of an actor as assessed by his or her team members. Given the trust and

relational basis of these networks, degree centrality scores can mark the actors that emerge in each team as a primary resource for technical, programmatic, and ethical issues, as well as how assessments of friendship align with or diverge from those assessments. In both networks in Class A, the two advisors had the highest in-degree centrality, indicating that across both constructs, members felt they could go to advisors or perceived them as experts in those respective areas. The networks for Class B did not centralize the advisors, and actors' positions after the advisors shows how technical and ethical trust are established on these teams.

In the technical network for Class A, the two TAs followed, first Erinn and then Ertie, followed closely by the Project Manager, Danielle. The next tier of high scores was comprised mainly of Design Leads. There were a number of high or moderately high scores in this network, indicating that many individuals perceived a number of their team mates as technically competent to some extent.

It is not surprising to find that high levels of technical expertise are associated with individuals in positions of authority and greater experience on technically complex engineering design project teams. In Class A, the two advisors and TAs emerged as having among the highest degree centrality scores in the technical, program, and ethical competence networks, with Danielle the Project Manager ranking alongside them. Class B's pattern of centrality scores did not follow the same hierarchical progression. One TA, Eshni, the Project Manager, Saul, and Ryan, a general team member freshman with no formal role, ranked above the advisors in technical competence, while the three advisors and one TA, Eshni, ranked highest for ethical and program competence. Only two of the advisors, Dr. Kranks and Mr. Kowler, made the top four. Unlike Class A, the other

members of Class B generally scored much lower than these top four, indicating that team members presented a picture of a team with lower technical competence among the rest of their team members than in Class A.

These patterns of relations suggest that individuals in these teams assessed different kinds of relations very differently. Past research on information seeking in organizations supports the idea that individuals utilize a variety of premises to determine to whom to go when seeking guidance in certain matters (Borgatti & Cross, 2003). The density, centralization, and degree centrality measures discussed in this section all combine to affirm that insight. Degree centrality measures can be particularly applicable to exploring ethics in teams as centrality captures the extent of an individual's access to certain kinds of resources within the network, including task-specific knowledge or information about the project and its history (Sparrowe et al., 2001). Ethical knowledge and resources are a critical component of these project teams. Recalling Borgatti and Cross's (2003) premises for information seeking in organizations, two of the three important considerations were knowing and valuing what a person knows. The differences among these three measures for the technical, program, and ethical networks in these two teams suggests that different kinds of knowledge are valued in distinct ways- for example, with higher density and lower centralization, technical competence seemed to be a more prominently considered and evenly distributed component of these teams' relations, while ethics was somewhat more centralized among only a few members of a team who could be seen as appropriate resources. The patterns in the degree centrality for the different networks also suggest that different people emerge as the primary resources in different areas of consideration. For example, while formal positions of

authority seemed to influence assessments of technical competence, different attributes seemed to affect to whom one would go for an ethical consideration. These findings suggest that not only are different people prominent in different kinds of relational networks in these teams, but also different kinds of knowledge are valued distinctly.

These findings also provide a network approach to understanding information sharing and its effects in a small group context. Recalling the research on information sharing by Reimer et al. (2010), teams are more likely to discuss shared information to which all the team members have access. While this study did not primarily focus on team discussions, the patterns of relations evidenced by the SNA suggest that team members are less aware of or less likely to identify others as ethical resources when compared with technical and programmatic resources. This could be partially explained by the learning environment. Although EPICS offers multiple ethics lectures, surveys, assessments, and teaching moments, there is, by virtue of the nature and meanings of the work, a greater emphasis on the everyday work of design in technical areas and problem solving. This finding is further considered and elucidated in the next section, which brings in the descriptions team members offered of their work experiences and team discussions and considerations.

The social network analyses and their visual representations act as agents in interaction, mapping the informal relations that have emerged on these teams around technical, program, friendship, and ethical relations in this design context and illuminating how different team members emerged as different kinds of resources on these teams. I discuss some interpretations and significance of these results in the following section, where I consider these findings in conjunction with the qualitative

analysis of team member interviews. In keeping with the mixed approach presented in this dissertation, these findings are discussed in conjunction with insights from the results of the social network analysis. I pull from these insights generated through the social network analysis to help explain some of the qualitative findings, including the ways students talk about these relations and how the actors with high degree centrality in each network are discursively constructed as such, as well as complementing some of the social network findings with these insights, to provide a richer look at both sets of data.

4.3 Discursively Constituting Design Experiences

The social network analysis provided insight into how team members' informal relations developed in these teams surrounding technical, program, friendship, and ethical relations. The second part of this study utilized a discursive approach to interview data to probe deeper into how ethics and design work were perceived and understood on these teams to answer my second research question (RQ2): How are technical, program, friendship, and ethical relations communicatively constituted in these teams?

To answer this question, I conducted a discursive analysis guided by the principles of discursive psychology on two levels: first, within each individual interview, to explore how individual participants discursively handled and managed these issues through their talk in their interviews; and second, across the data set as a whole, to identify commonalities and differences among how all the participants talked about and handled ethics and design work in their teams. The social network analysis provided insight into how team members' informal communication patterns developed in these teams surrounding technical, program, friendship, and ethical relations. In keeping with the mixed methods used in this overall qualitative research design, I complement these

findings with qualitative insights to further support and make sense of the role ethics and design work occupy on these teams. These findings provided insight into how team members communicatively create and engage in these networks, and helped elucidate some of the informal communication patterns found in the social network analysis.

This analysis explored the different ways participants characterized and constructed themselves and their team members in terms of technical, program, friendship, and ethical relations. Technical competence was articulated in terms of levels of experience and possessing certain project-relevant technical skills. Program competence was constructed in terms of levels of experience and longevity with the team. Ethical competence was constructed in terms of longevity with the team and interpersonal attributes. Students had a difficult time articulating and justifying characterizations of ethical competence in comparison to the other two kinds of competence. These findings provide some insight into the kinds of knowledge that are valued on these teams and the different ways those kinds of knowledge are distinctly constructed.

4.3.1 Technical competence

Participants invoked certain characterizations when describing or justifying someone as technically competent, and they were quick to offer examples and rationale for these characterizations. Students appealed to levels of experience and possessing specific skills in characterizing a team member as technically competent, and they drew a distinction between two kinds of technical competencies related to their project teams: more general, engineering-focused technical skills that often aligned with seniority or disciplinary affiliations, versus skills and abilities related to the specific project and its needs.

A major quality of the construction of technical competence articulated by the participants was the ability of participants to offer "evidence" or specific justifications for their characterization of a team member as technically competent. Sam (Class B) privileged his position as a senior, positioning the freshmen on his team as incapable of being technically competent by virtue of their class ranking: Sam also appealed to disciplinary knowledge in his construction of technical competence:

> So, I would've put Sean for this one, but neither one of us has the technical ability for this. The project that we're working on right now is pretty heavily electrical engineering, and neither one of us has a substantial background in double E [electrical engineering].

Sean (Class B) also appealed to disciplinary knowledge as a credential for technical competence, and linked it to trust: "Because it's such a technical field and, you know, honestly, when people ask me how a computer works, I still say magic, because it's complicated and there's a lot of trust that is given to people who say they can do something."

Additionally, Sean and Sam expressed frustration with the dynamics of a team that incorporated a senior design team and several freshmen. Sean reflected:

> Sebastian and Steven both, at points, tried to . . . I guess be more involved with the design of the [device], and I think it kinda irritated me and Sam because we didn't want to have teach someone while we were doing it, and so we kind of just wanted people to leave us alone.

They both made assumptions that people outside their discipline would not be capable of learning the more technical side of the project, and acknowledged that they

had little desire to teach them. Steven, who was also a senior, was often included in Sam and Sean's mention of "the freshmen," and they characterized his inexperience and lack of expertise in terms of his non-computer engineering major.

Dennis explained that he picked "basically people who I thought knew the technology the most. And I guess I see the TAs as people who are grad—I mean, just grad students who are able to provide any input." Similarly, Dennis linked technical expertise with ability to provide technical guidance: "[I picked people] if I asked this person for help with something technical… If I had a problem with something technical, could I go to them?"

These constructions of technical competence were reflected in the patterns that emerged in the centrality measures discussed in the first section of this chapter. In both teams, a pattern emerged of privileging experience levels and seniority for the project team members in terms of technical competence. In Class A, the individuals with the five highest centrality scores in this network all had seniority and established experience, including the advisors, TAs, and a graduating senior who had been in the program all four years of her undergraduate education. The Design Leads for four of the project teams in Class A were returning members who had been with this particular project the longest. On several project teams, a team member with a lower class ranking could serve as the Design Lead because of his or her engineering-specific technical skills, as was the case for a team in Class B in which a freshman (Reid) served as the Design Lead while a senior (Russel) occupied a general team member position.

Reid and Ryan were both identified by their fellow team members as highly technically competent because they were perceived as having worked the most with the

design and building of the project. Both were freshmen and only Reid held a formal position on the team, but participants characterized both as highly technically competent because of their significant involvement with the design of their product. One of their teammates, Ray, explained his take on their technical competence:

> If I went to them about something technological that they're at least familiar with, I'd basically trust their opinion on them and follow their instructions… Like I'd say Ryan and Reid are probably higher up in the competence than others. Mostly because they worked with it the most during our project. Like those two worked pretty closely with each other on the [device] model.

Despite their freshman class standing, their fellow team members recognized the technical skills of these two individuals, framing them as significantly contributing to the direction of the overall project. Seniority and levels of experience were very important to students' conceptualization of technical competence, as evidenced by these qualitative findings about the students' attributions of technical competence and the degree centrality scores generated for the teams. However, the discursive analysis revealed a second theme that conceptualized technical competence in terms of more project-specific knowledge. While engineering-specific technical skills were commonly identified as important justifications for describing technical competence, students' talk about their projects also articulated a second, distinct more general characterization of technical competence as almost *any* general specialization that was relevant to the project, and particularly those more oriented toward project management. In most interviews, general expertise relevant to the project was constructed as even more important than more engineering-focused conceptualizations of expertise or seniority, even when the latter

may have been more pronounced. In the previous example, while Reid was acknowledged by all of his team members as the person most involved in the technical side of the project, they still deferred to Russel in almost all matters--including technical ones--and constructed him in their talk as the true leader or guide for their project.

Danielle (Class A) described her conceptualization of technical competence:

> So technical skills, for me, really depend on the project. So that's coding in Arduino, building a circuit board, doing CAD modeling, any hands-on skill that kind of builds and progresses the project is what I would define as technical skills.

At first glance, it seems that specific engineering skills were important credentials for technical expertise in her description. However, she also linked those skills to the advancement of the specific project and even included "any hands-on skill" that advanced the goals of the project. While she did seem to privilege skills that may be more traditionally aligned with engineering competencies, she framed the importance of those skills in terms of the specific project rather than the more general characterization of skills as qualifications in their own right that was articulated in the examples above.

Russel (Class B) articulated a project-skill characterization of technical competence that deviated even further from the engineering skills conceptualizations:

> Ryan was awesome at doing the 3-D design software and actually getting stuff 3-D printed, so if we needed something to be done, we went to him and we knew he had the technical competency and also the work ethic to get it done. Whereas Reid had more of the leadership skills, so he was kind of managing different projects and stuff, so I *guess* that's a technical competency.

Here, Russel first acknowledged Ryan's engineering skills as important to both the team and to his conceptualization of technical competence. However, Reid's project-specific contributions were constructed as a technical competence, even though they did not explicitly involve engineering-specific skills or abilities. While Russel still included both in his conceptualization of technical competence for his project team, he described these competencies as distinct.

Danielle's (Class A) described her selections for technical competence, particularly pointing out the Design Leads for each project team, from her perspective as the overall team Project Manager:

> These are all—I mean, I've seen their skills, they've been on the team. They're usually the driving force behind the project as well. You know, I've seen that as kind of a pattern on the team, is Design Leads have a clear vision of what needs to get done, and kind of can take the project in their own hands and lead that project on their own, without too much issues or dependency on the advisors or myself or the TAs.

In this quote, Danielle appeals to her team members' formal positions as Design Leads, which seems to carry a sense of credibility. While she still identified the Design Leads, who were all returning members, as the pinnacles of technical competence in her class, she did not frame this competence in terms of their seniority or even their engineering skills. Rather, she constructed their technical competence in terms of familiarity with and adherence to the project and its goals and "vision." She discursively valued their contributions as being the "driving forces," "having a clear vision," and other markers of being able to lead and guide their projects independently. Again, this was in

contrast to some of the articulations above, which valued engineering skills as technical competence in and of itself.

This tendency participants demonstrated to construct technical expertise in terms of alignment with the specific project history sometimes privileged project-specific knowledge to the point of devaluing or limiting participants' acknowledgements of team member contributions--even if they had specific, demonstrated technical competence in their own discipline--if that competence did not specifically apply to their project. When asked about why he did not include team members Dennis and Danielle in his technical network, Danny reflected on this tendency and even acknowledged that it may not be a fair way to view technical competence:

> It's understanding what our current design is and why it works. It's kinda unfair because Dennis Dougherty is a nuclear engineer and Danielle is a mechanical engineer, and a lot of the electromagnetic stuff is stuff that they'll never learn. They don't need to understand why it works—I don't really understand why it works—but we just need them to understand . . . what we're currently doing and what happens, so the cause-and-effect relationship of our design.

A more pronounced example of this privileging of project expertise over general technical expertise was demonstrated in the case of Daren (Class A). Most members of Daren's project team identified him as significantly technically skilled in their interviews. He was a graduate student and brought specific technical expertise to a part of the design that was acknowledged by the team members as essential. In the weekly observations, Daren was always working on highly technical aspects of the project. However, he was not included in many of their technical networks and rated an in-degree centrality of only

5, which placed him below 21 of the 25 members of his class. In their descriptions of their team's work, participants even put him in the same category as Diane, a freshman who was generally acknowledged as having little technical skill or input on the project. Both Daren and Diane were often excluded from descriptions of team values, goals, and identity, and participants positioned them as outsiders or peripheral to the project team. In fact, Danny pointed out halfway through his interview that when he used the term "we" to refer to his project team, he did not mean to include them. While Diane was often excluded on the basis of being a freshman and not very involved, thus lacking in both of the common ways technical competence was evaluated in these teams, Daren's team members' talk about him revealed an interesting element of how students were characterized by their team members. Dennis described Daren's contributions in this way:

> As far as I can remember, he's commented on a lot of the design features that we have in terms of like the actuation of the pins and everything. He's commented on those because he . . . I think industrial engineers, they have to take their basic physics courses and all the stuff like that, so he's provided that kind of input. But he's been mostly working on his own for the user-interface thing.

Dennis' description here excluded Daren from the team process by saying he "commented on" aspects of the design, rather than saying he contributed or assisted with the design. Although Daren's team mates all discussed in their interviews how technically skilled he was, and how much he was contributing to the project, their talk also revealed a sense of in-group/ out-group division. That is, Daren was discursively

positioned as “other” or not a “real” member of the group. This finding is further probed in the following sections.

As this analysis shows, students articulated a distinction between technical competence as engineering-related skills versus program-specific contributions. The next section of this analysis discussed in further detail the role and value of program knowledge that was articulated by the participants.

4.3.2 Program Competence

As the last section showed, these participants placed a high value on program-specific knowledge and contributions to their projects. While technical competence was a primary focus for engineering design team work, the importance of knowledge related to the program in which these projects were situated was also examined. This analysis found that program competence was valued differently, but in some ways, similarly, to technical competence. Students associated program competence with levels of experience and longevity with the program itself.

Program competence was linked to knowledge and understanding of the resources, policies, and procedures related to completing project goals that were specific to the EPICS program context. Students who were seen as high in program competence were often valued as an important resource for some of the “behind-the-scenes” aspects of the project, as well as being facilitators who were able to navigate getting materials, managing the budget, and knowing who to talk to in a given situation.

Program competence was often described as a contrast to technical competence, and did not require an engineering background or knowledge base. Students often described individuals who had been with the project for multiple semesters as having a

certain kind of authority that in some cases even trumped technical skills. Students said they would approach these people most readily for questions or when they encountered a challenge in the project. Dennis (Class A) described his approach to program competence, tying it to familiarity with the processes and procedures particular to the program:

> Basically just experienced with EPICS, and I thought of, um . . . I definitely thought of people who had roles in EPICS, like as in like project partner, like something like that, so they just are familiar with like the EPICS way of doing things. Because I know Danny and just other ambassadors for EPICS, they have the proper EPICS competence. I think project competence falls under that scope as well.

Similarly, while Erinn and Ertie were both teaching assistants for Class A, Erinn ranked higher in the program competence network and was often described in interviews as "the" TA Danielle described her own view of the distinction between Erinn and Ernie: "Erinn actually used to be on [this team], and she's been through [this program], where I know Ernie I think is brand-new to the program." She went on to explain how this longevity with the program impacted her assessment of the two in terms of program competence:

> It's not his ability to be a TA. Like, he's been great, really helpful, but I know . . . at least in comparing the two, I would have stronger confidence in Erinn than Ernie. Like I said, there's a learning curve for everyone, and I have no doubt that—you know, he's been doing a good job, but I've also seen Erinn kind of leading that front.

These assessments also suggest the reason for the high scores of most team members in this network as well. Returning members were assessed as having greater program competence, regardless of their class standing, major, or other factors. Referring back to Figure 2, the members on the most extreme edges of the network were all first-semester participants in this program. Diane, Quinn, Ziyu, and Zach were all participating for their first time on any project in this program, and they all rated lower in this network despite other differences such as class level (they include Freshmen through Seniors) or major. Diane articulated this sentiment concisely:

> Okay. Basically I put everyone except myself and Daren because …I know this is his first time working with the project, and I feel like him and myself just because we don't know really the background of the project. But everybody else I think knows. Like obviously Dr. Kastan and Kristopher know … what [this program] is and the history of the project. I think they've been involved since the beginning. Danny and Danielle and Dennis I'm pretty sure have all been there since the beginning.

Diane places herself and Daren on the same level of non-expertise for this network, despite Daren's status as a graduate student and expert in his area. For his part, Daren also articulated this sentiment: "It's not really an engineering kind of thing; it's more just a [program] . . . you know, if you're in [the program], you need to learn how to do this." These findings all suggest that program competence is distinct from competence and is assessed distinctly by team members. Clearly, the members of this team see program and technical competence as different kinds of resources within design work.

4.3.3 Friendship

Friendship played a role in both the construction of ethics in these teams and in design work. Friendship also played a role in the development of team norms and the patterns of relations that characterized these teams. In analyzing the role of friendship in these teams, this analysis found that friendship was constructed as both a boon and a potential hindrance to design work, and friendship impacted students' descriptions of the communicative resources they would pursue in their teams. These findings suggest that friendship relations may impact both the formation of team ethical (and design) norms, as well as how and why individuals assess their teammates' competencies.

The first theme in this section was the construction of friendship as both a boon and a potential hindrance to design work. Students described friendship as a way to better collaborate and engage with others in a team-based project context, or else as a potentially negative impact on those same processes. For instance, Shayna (Class B) described the impact of friendship on her engagement in design-related work:

> I think it makes me more comfortable to talk to people and share ideas. I feel less obliged to share an idea if I'm not sure of it, especially if they're not friends with me. But also, it can also be trickier, because if we have a disagreement, I don't know how to handle it without hurting the friendship.

In this conceptualization, friendship was also often constructed as a form of project-related support. Saul (Class B) described his distinction between a friend and an acquaintance: "A friend is somebody that I can look to if . . . not necessarily talk about something super personal, but it's a difference in communication"

Shawn (Class B) framed the impacts of friendship in terms of one's ability to give feedback and share opinions:

> I think it can have both negative and positive impacts. If you're too friendly with somebody in a design situation, when there's that area where you want to be friendly but you don't want to say anything critical to them, then that impacts your design process because you're just going to go with whatever they're saying. But if you're to the level either you're not friendly to the point where you're going to go do that and you can still be critical, or you're to the point where you can be critical and call them stupid. You know, there are different levels, so it depends on where you are on that friendship level scale.

Saul (Class B) additionally echoed that the *level* of friendship was an important determinant of its impact on design work: "Some people are just not comfortable with calling people out if they're friendly with them, because then that impacts your friendship. So there has to be either a disconnect or has to be really a tight-knit group of friends."

Friendship also impacted other types of assessments between team members. For example, Shayna (Class B) discussed her feelings about the other project team in her class. She first mentioned that she had included Ryan as a friend, and that she had excluded Reid after deciding she didn't "like him" anymore:

> Ryan was talking about how he felt that he would've done a better job with Design Lead and he gave up the position to Reid. And I was like, I think Ryan would've made a much better Design Lead, and I feel like—he basically built the whole [device] by himself.

Shayna's depiction of the other project team's interactions revealed some interesting insights. While she admitted elsewhere in the interview that she had very little interaction with or knowledge of the other project in her class, here she uses her favorable assessment of Ryan to justify her assertion that Ryan had done the most work on that project and was a better leader for that team. When I asked how she knew Ryan had done almost all of the work alone, she said that was what she had "heard." This description conflicted with the descriptions offered by every member of the other project team, who described Reid and Ryan as both working significantly on their design and Reid doing much of the work. However, Shayna's feelings of friendship for Ryan seem to have colored her depiction of not only Reid and Ryan in relation to her as friends, but also her assessment of both of their work ethic and technical contributions to their project.

While friendship relations seemed to have an impact on some aspects of engagement with and perceptions about design work, it also impacted students' descriptions of their engagement in the processes surrounding design work. Specifically, friendship was offered as a justification or motive in a students' talk about their comfort in going to a particular person on their team for different resources, including technical help, programmatic concerns, and ethical guidance.

For example, Sam (Class B) was a senior design student with exceptional technical skills related to computer engineering, and this fact was discussed by all of his team members and even some members of the other project team in this class. However, Sam maintained a strong distance between himself and the rest of the team, only significantly associating with Sean, the other senior design student. This fact was evidenced through the descriptions of Sam and his team members. Interestingly, Sam

received very low scores for degree centrality in the technical network. In probing this surprising finding, I looked at his centrality scores in the friendship and program networks—in both, he was among the lowest five scores. While his team members universally acknowledged and praised his technical competence, they did not express through their talk or through the network structures that they would trust or feel comfortable relying on him for technical concerns.

The impact of friendship on the trust relations that were examined in this study may have affected the flow of resources and the patterns of interactions that characterized and facilitated design work in these teams. For example, while Sam had significant technical competence, he was not portrayed as a technical resource for his team members and was low in his degree centrality in all of the networks. These findings suggest that the patterns of relations that emerged in the network structures and were discursively constituted by students in these teams may have played a strong underlying role in the development of group norms that in turn helped to govern team member interactions. While this study was not able to investigate interactions in practice on these teams, the students' descriptions of these interactions seems to support this claim.

Here it is useful to recall that the items that were used in the SNA survey probed patterns of *relations*, not necessarily *interaction*. That is, these networks evaluated how comfortable an individual was in relying on or trusting a team member in a given context. As such, it makes anecdotal sense that feelings of friendship would be associated with how much trust and comfort was placed on different people. An important consideration of this relation is the potential impact on team norms and team climate. These findings suggest that simply having individuals with the right set of competencies may not be

enough to promote effective or ethical project design work, but that team climate factors may instead be similarly or potentially even more valuable. This emphasis on valuing team members in terms of their contributions to team climate and positive work flows was borne out in the students' discussions about relying on others in a technical context. Many students articulated a recognition that the *willingness* to find the resources needed to help a person accomplish a task was also important to their evaluation of that person's competence.

A second consideration in examining these findings was that of identification. Cheney (1983) defined identification in an organizational context as a sense of belonging, which is often associated with the creation of in-group/out-group distinctions and privileging interests related to the object of identification. Identification can have different targets, such as individual, work group, organization, or occupation (Scott, Corman, & Cheney, 1998), meaning that identification could manifest in project teams or on a broader scale, with engineering generally. In the original conceptualization of this study, a major point of interest was the development and impact of team norms and an examination of how different team norms could impact ethics and design. Through the interviews especially, it became apparent that the feelings of friendship and associated senses of closeness, in-group/ out-group distinctions such as those articulated by Daren or Sam's teams, and the associated tendencies to preference interests of the group over the individual and development of social identities were all undercurrents to the students' descriptions of how and why their teams worked and how they engaged with design. For example, Daren's team failed to value his contributions to their design process in part because he was never accepted into the "core team."

One of the project teams in Class B also manifested an interesting dynamic related to the issue of identification. At the start of the semester, they were six team members, four of whom were freshmen. The senior design team of Sam and Sean were not added to the class until several weeks in. In their interviews, the initial six members referred to themselves as "the originals" or "founders," and used numerous discursive markers to indicate that *they* were the in-group and the senior design team was *other*. The "originals" in Sam's team limited the useful flow of information between themselves and the senior design team seemingly in part because they were trying to protect the in-group/ out-group distinction they had collectively constructed. The constitution of these project teams themselves, including who is granted membership, who is kept at arm's length, and whose input is considered, have implications for the kinds of knowledge that are valued on these teams and from whom that knowledge can come. Through these considerations, it seems likely that constructions of friendship and the patterns of relations that emerged in these teams help to discursively constitute the nature of design work and may form the basis for the behaviors of team members, in line with a structuration-based social network approach (Whitbred et al., 2011). These team processes may be seen as operating as "rules" or norms that guide what behaviors are seen as acceptable, and in this case, whose contributions are valued and considered. These group norms, in turn, seem to affect the ethical climate that is constituted for these teams. Recalling the concept of the duality of structure, this reflexive relationship is an important part of the constitution of the patterns of relations and the ethical team climate in which these teams operate. Thus, while friendship is in many ways the least concrete construct probed in this study in relation to design work, friendship relations have a

major impact on the ways in which individuals engage on these teams around the other three constructs, and contributes to the ethical team climate that reflexively shapes and helps to constitute ethical work.

4.3.4 Ethical competence

While participants were readily able to offer "evidence" and justifications for their characterizations of team members as technically and programmatically competent, this analysis found that students were less comfortable articulating ethical assessments of team members and struggled to justify those assessments they were able to articulate when asked directly who they included in their ethical networks on the SNA survey and why. Additionally, I found that students' descriptions revealed a tension between assessment of ethical *character* and identifying ethical *authority* in others. These findings provide some insight into the lower density for the ethical network, suggesting that participants may have identified fewer team members as ethically competent in their responses in part because they were less comfortable assessing that competence.

Participants drew a distinction in their ethical assessments between ethical characterizations of others and describing others in terms of ethical guidance. That is, they more often identified authority figures who were able to help them solve or address an ethical problem, while they identified peers and those with whom they felt comfortable as ethical confidantes. While participants constructed both as ethical "experts," they differed in how they would interact with them in the context of their project. For example, Ray (Class B) described his criteria for inclusion in his ethical network: "I was thinking someone almost in charge of something, and that I could basically trust the decision *to them* about something." Diane (Class A) described hers

similarly: "Okay, basically, I just put Danny and Danielle and then Kristopher and Dr. Kastan because I feel like they're the ones who are in charge and really know what's going on and would know the appropriate way to handle that." Reid (Class B) offered a somewhat more nuanced explanation:

> I just thought about, um . . . a lot about who I would trust to take care of something or realize that there was like a problem. Like I trust Rachel's and Reid's and Ray's ethics, but I probably wouldn't go to them with an ethical concern, just because I don't think it would be taken as seriously as Russel or Raquel or the advisors would take it, if that makes sense.

Here, Reid parses out a distinction between ethical advice-seeking and ethical characterization--he says he would trust some members ethically, but would not go to them for ethical problems. Indeed, while many participants identified ethical authority figures and framed ethical competence in instrumental terms, a second theme emerged throughout the interviews that diverged from this theme. Students also constructed ethical competence in more general terms of ethical *character*, identifying team members who they felt *embodied* ethics. Many participants expressed a feeling of closeness or a shared history with a person as a justification for an ethical portrayal of that person. When probed, many participants could not offer specific evidence or support the way they often did when justifying technical or programmatic competence. Instead, they appealed to intangible qualities like "gut feelings" to explain these ethical assessments. Unlike the levels of expertise that students used as a justification for technical and program competence, students articulated a link between ethical characterization and familiarity, often outside the project context or even just based off inference. In these

characterizations, students often discursively positioned the team member as familiar outside the project--more than "just a teammate," in other classes together, living near one another or even knowing that person from before coming to the university. These allusions to share history and familiarity were often invoked when students described a person as ethically competent, and indeed this was the closest to a form of "evidence" that was offered in the ethical characterizations.

For this theme, participants often identified interpersonal attributes for these characterizations, and linked ethical assessments with indicators of team climate. They spoke in terms of which team members would make them feel comfortable or would be open to such discussions, explaining that they would feel "comfortable" going to a certain person or they believed the person would be "open" to engaging in discussion about the ethical problem.

Indeed, many of these justifications aligned with past scholarship related to the cultivation of an open team climate. These behaviors are related to team members feeling more comfortable sharing opinions or challenging ideas, and ultimately relate to better team decision-making and problem solving. The fact that these qualities emerged as central to ethical descriptions in this study suggests that while students may not feel comfortable explicitly naming or identifying ethics in their teams, they are on some level aware of the positive effects and overall importance of affirming behaviors that contribute to a positive, supportive, open team climate.

This link between ethical characterizations and team climate influences needs to be explored further, but it may suggest that ethics may be rooted more at a relational level, at least for these specific teams. By this I mean that unlike technical and program

competence, which can be taught through a series of specific methods and discretely categorized and named, ethics in project-based teams may be more firmly rooted in the team climate and team norms that develop within groups.

On the whole, students struggled to articulate these ethical characterizations and offer justifications for them. Many participants demonstrated discomfort and difficulty with articulating ethical assessments of team members, using numerous vocal fillers and often deflecting the question or qualifying responses with phrases such as "I'm not really sure" or "I really don't know." This differed significantly from how they talked about technical and programmatic competence, where participants often spoke with confidence and used few if any qualifiers when justifying their characterizations. While students appealed to specific skills and project-related experiences when constructing technical expertise, they were far less comfortable justifying their ethical assessments of others and struggles to *point to specific attributes or credentials in their characterizations of ethical competence in their teams.* Many of these justifications appealed to some intangible force, with phrases such "it's a gut feeling" and "there was just something about them" offered frequently.

Indeed, participants even talked more confidently about *not* being able to make an assessment of a team member's technical competence than justifying characterizations of others as ethically competent. Throughout the interviews, participants often explained that they had not worked closely enough with an individual or know enough of the person's credentials to assess his or her technical abilities.

Ray (Class B) attempted to explain why he excluded a team member from his ethical network: "Ryan, while I feel he's kind of a leader in the car project and the car

part of it . . . not exactly sure how to put it, but . . . yeah, I'm not really sure how to put it, sorry… I might ask him about little things, but for serious matters, probably not." Ray begins by acknowledging Reid's technical competence, which he had already described earlier in the interview, but then struggled to justify his exclusion from the ethical network. He seems to draw a distinction between technical and ethical competence, and while he was able to offer numerous justifications of his inclusion of Reid in the technical competence (his experience with the car, his extensive work on the project, his demonstrated specific skills), he struggles and ultimately fails to offer and justification for his characterization of Reid as not ethically competent.

This inability to articulate and justify assessments of ethical competence, and the prevalence of these two distinct conceptualizations of ethical competence as authority and embodiment suggest that the participants were somewhat unclear or conflicted about what ethical competence means and how it is manifest in their teams. Indeed, both conceptualizations often occurred together in different parts of most of our interviews. These findings suggest that students lack a framework for applying ethics in the project context. Their ability to not only characterize technical competence in similar and definable ways contrasts sharply with their inability to justify or support ethical assessments of team members, defaulting instead to appeals to interpersonal and team climate considerations. These findings suggest that there is a clear distinction in how these participants discursively handled technical versus ethical competence assessments.

4.4 "Everyday Ethics" in Multidisciplinary Design Teams

In this final section, I explored how ethics is manifest in these teams and how students perceive it in relation to design and team-based work to answer the final research

question (RQ3): How is "everyday ethics" communicatively constituted in multidisciplinary engineering design teams? Throughout the first two sections of analysis, it has become clear that ethics occupies a distinct space on these teams. Students interact and talk about ethics and ethical competence distinctly, and often with some level of discomfort. While students struggled to explicitly identify or name ethics in their project teams, many were able to come up with a real example of an ethical consideration relating to their project when pushed. However, in their descriptions of the design work in which they have been engaged, it became apparent that they were indirectly alluding to some ethical motives and responsibilities. Specifically, this analysis found that while students articulated a constant tension in balancing the different design priorities of desirability, viability, and feasibility, their talk overwhelmingly indicated a human-centered orientation toward design that included some clearly ethical considerations.

Initially, students struggled to identify or explicitly acknowledge ethics in their project teams. During the interview, one question explicitly asked about ethics by asking, "What does ethics mean to you? Try to define it." This was followed by probing questions pointing to personal versus engineering ethics, and asking about ethical issues encountered on the person's team (for full protocol, see Appendix D). Almost every single participant came to a halt with this question, using multiple vocal fillers and taking long pauses where they had not previously in the interview. The majority of definitions included references to "doing the right thing," not inflicting harm, appeals to the "greater good," and other instances of what Lloyd and Busby (2003) refer to as "disaster" scenarios. When prompted to reflect on what ethics meant in the context of engineering,

students were again only able to identify "disaster scenario" examples, heavily linking ethics to the potential for harm, or very simplistic notions of ethics. While this tendency to view ethics primarily in grand, "disaster" scales, these articulations did not show evidence of the conceptualization of "everyday ethics" (Lloyd & Busby, 2003; van de Poel & Verbeek, 2006) as implicit throughout the design process and present in all design decisions, both great and small. While recognition of major issues is important in an engineering education context, this view of ethics does not allow for an integrated understanding of the way ethics is implicated in the micro-level everyday decisions and reasoning associated with design (Lloyd & Busby, 2003). This more nuanced understanding would "provide a firmer basis for thinking about ethics in the engineering design process" (p. 514) and might encourage more incorporation of ethical thinking into the entire design process.

> Sebastian (Class B) articulated his struggle to conceptualize ethics:
>
> Something is ethical to me if . . . (exhale). Words like that, they're hard to just, um… I don't know. I think of something as ethical if it's doing the right thing, and that's just another word—the right thing—like, um—

Saul (Class B) similarly struggled to articulate his definition of ethics in engineering:

> To me ethics is, um . . . especially in regards to engineering, is a, you know, a . . . moral guideline. I know it's not necessarily morals, but the ethics behind engineering and the design is, is it going to be beneficial, more beneficial than it is harmful?

This theme of harm was prevalent in many of the definitions offered by the students. Sean (Class B) also deferred to established codes in his definition, while also acknowledging that ethics may not be *only* identifiable in the potential for harm:

> Ethics would be, to me . . . I guess the Hippocratic Oath, do no harm. Um . . . I think if there is technically no harm done, I suppose you could still do things that are unethical, like cheating, misleading.

Steven (Class B) reflected on ethics in his specific project:

> Because it's like, we're building [this device] for little kids. So I guess if little kids can hurt themselves with [it], but that's like . . . little kids can hurt themselves with anything, so is it any more dangerous than kids having compasses in class and drawing circles? Because I could murder somebody with a compass.

Steven's definition suggested that ethics in engineering was linked to safety and limiting the potential for harm in his product. He then compared the risk for harm associated with his device to the risks faced in everyday life by his users, putting some accountability for the potential for harm on the users themselves.

Abbey (Class A) began her response to this question as a test of her knowledge: "Oh gosh, this is bringing me back to Engineering 131 and 132 (laugh)… I'm trying to remember what we learned." Her response implied that there was a "right" answer, or that ethics in engineering was something strictly definable

Zander (Class A): "Yeah, when you're a professional engineer, don't steal other people's designs or ideas. Don't take credit for that kinda stuff. What else? You know, I've never given it much thought."

Zander's reflection was representative of the overwhelming sentiment expressed by the participants, which was that they didn't often think about- or in some cases, they didn't really understand—ethics. However, upon analyzing students' descriptions of their project more generally, a strong ethical orientation emerged from their talk. For example, one interview question asked the participant to broadly explain their project: "Tell me about your project, and the purpose of your project" (see interview protocol, Appendix D). Most students answered this question and included specific mentions of the end user's needs or desires, rather than narrowly describing the technical details or the overall project. For example, one project in Class A was focused on developing an assistive technology similar to an existing extremely prevalent personal technology that would increase accessibility for a people with disabilities. All five members of this team expressed the need this population has and their personal surprise at the experience this population must have, given how they themselves take for granted the use of this technology every day. Danielle mused:

> I guess one thing, and looking back on it, it's common sense that you would think this, but they were telling us how they would [try to do these really common activities], these students that I think were in seventh or eighth grade, and it's something so second nature to us, we didn't even think of that application of our device. We were thinking more on school, on textbooks, and like reading full books, you know, that they can download from the Library of Congress.

This recognition of ethical considerations in the little, everyday aspects of a project was rare. While this may not be surprising, as many of these projects involved human users and the development of products to help them in a variety of ways. But it

does stand in contrast to other models of design discussed in Chapter 2, which may privilege different considerations, such as the product itself as the major consideration that is then imposed on the user. This user orientation was also extremely prevalent in the motives and intentions that emerged in the students' descriptions of their involvement in this program. While these projects were all conducted as a part of a course for credit toward a degree, the majority of students instead focused on desires to help the world, give back to the community, or do something meaningful for those around them.

Danny (Class A) expressed this sentiment in his frustration that his team members were not putting in as many hours on their project as he was: "I was just consumed by this passion to help these people, and I know they were, too, so it was just really confusing me why they weren't going above and beyond."

This human-centered orientation was recognized by the students as a unique take on design in their engineering education experiences, and they acknowledged that it affected their ultimate designs and products. Danielle (Class A) summed up the HCD orientation of EPICS that emerged throughout many of the students' descriptions of their everyday work on these teams:

> That's the thing that I really enjoy about EPICS, is the human-centered design aspect and always keeping the stakeholders in mind, kind of drilling that into our heads. Because I feel like outside of the EPICS program, if you're not fully exposed to it, it's not a priority on other engineering teams. I've seen that with the [project] itself, because we actually got the project the same time a Senior Design project in mechanical engineering got the project, and they came out with something that, you know, had all these gears and gizmos and all these fancy

> things, but it weighed 500 pounds and still didn't work. And then we had a team that was, you know, freshmen, sophomores, juniors of all different disciplines, we come out with a design that was under 20 pounds and had a pretty legitimate mechanism inside it to make it work.

The human-centered orientation was reflected in many of the participants' descriptions of their design work experiences, and emerged as a central characteristic of the motives of many of the participants. However, as the design process moved into the technical details, team members articulated a more narrowed scope of the design process and design priorities but seemed not to recognize ethics as a part of that process. Ethics was often discussed as an external factor to be considered at an appropriate time, rather than recognizing that adhering to standards and doing good technical work are ethical considerations. Recalling the EPICS design process discussed in Chapter 2, different goals and priorities are emphasized at different points throughout the life of the project. While student membership shifts every semester, the project itself lasts for a number of semesters, often giving students the chance to experience only a few of the steps in the process in a given semester. Students described the more technically focused phases less in terms of concerns about the user. In fact, many participants justified their assertion that their projects had incorporated no ethical considerations by adding that they did not have involvement with a project partner or specific user at a given point in time. In their descriptions, the students' articulations of the role and identification of ethics suggested that they primarily considered ethics in the realm of interactions with a project partner or user. For example, Harrison was unable to think of any ethical issues the team has faced thus far, saying: "I don't think we've done much involving—because of the phase of

where the product is at, they haven't done much involving the users." This response linked ethics to users, and situated ethical and user-centered concerns as part of a *different* phase of the design process. That is, participants were only able to come up with an example of an ethical concern their team faced if it explicitly involved the user, or if it was a large-scale safety issue. Students seemed to articulate conceptualizations of ethics on their project teams as bounded to a particular part of the design process. For example, participants were asked whether their teams had faced any ethical considerations (see Appendix D for interview protocol). Abbey (Class A) responded: "Not quite yet. I feel like that'll come into play more once we have our project partner." Zander (Class A) responded: "I could just be blind, but I don't know. Yeah, especially in my project team, because we don't have a user."

Similarly, Daren, an interaction design graduate student who joined the team, caused frustration on the team with his specific focus on the user experience. Danny expressed his take on this tension, saying that Daren's focus was not appropriate and maybe even distracting for the team: "It was really confusing because he came in and everything he wants to do, it's *so far out*." His frustration implied that such a specific focus on the user's experience with the product didn't make sense during the conceptual phase, in which technical functionality was the primary focus.

Danny continued this thought and described his team's assessment that user needs didn't fit into the current phase of their process, instead opting to delay that consideration until the functionality had been established:

> But we didn't go into *really* specifics about the user interface (UI) and how is this going to be meet the user [needs], because we knew that we had a really, really

> long time developing technology before any of that was relevant, and we didn't want to waste time. We got caught up in it for a little bit—how is this exactly going to work? What's the UI going to look like? And then we realized that we didn't need to do any of that; we essentially needed dimensions, we needed power consumption, and that was it. Because if the mechanism failed and it didn't end up working—and that's really the biggest part of the project, or the biggest hurdle we have to face—that there was no point in doing everything else.

In these examples, students seemed to discursively position ethics as an appropriate consideration for a certain part of the design process, but not as a permeating issue that must be considered throughout. This technical focus makes sense and is an essential part of engineering and design work. However, in their talk the students seemed to privilege *either* consideration to the exclusion of the other.

For his part, Daren's perspective on this issue was grounded in a disciplinary division:

> In our project in particular, I think it started out--the need came from the user, right? But with these teams full of engineers, it turns into an engineering problem, and they lose kind of sight of that user and how the user would use this device.

Recalling the findings discussed in the first section of this phase of analysis, Daren's team members likewise positioned his interaction design disciplinary identity as a major motivator for his approach to the project. This disciplinary distinction emerged throughout much of the students' talk about tension that arose on their teams, specifically when people's design priorities seemed to conflict.

These findings seem to align with past literature on moral intensity and its effect on ethical reasoning. The fact that many of these teams had real human users depending on their projects, and many were focused on assistive technology and learning outcomes, came out as a strong motivator for many of the students and as a primary way the EPICS program itself was characterized. For example, Sara explained her team's serious approach to their project: "And it's real-life stuff, too; it's not something small that we're doing. You know, they see the reward in getting their design prototypes back from the project partners and seeing how it's impacted their lives and improved them."

The concept of moral intensity also worked inversely for some teams. Sebastian (Class B) excluded his project from ethical consideration because in his words, this phase was just an initial test to see if the product worked. He described his team's product:

> This is basically just going to one teacher, and I don't see much of a[n ethical concern] with it because we're sending it to him and it's going to be just a lesson plan for a few weeks, and if it's effective, then great, and if not, it's just an experiment then and we can just narrow it down.

When asked if ethics would be more of a concern for him if the product was going to be distributed widely, he responded: "Um, it's different because there's a lot more people involved, it's more of a permanent thing, and it's going to affect a larger population as compared to just, you know, a few short weeks in one school in [another state]."

Sebastian explicitly articulated a notion that a product going to more people would be more ethically concerning, and he was not as motivated to worry about all the little ethical details given the small scope of his team's current objectives. This response

exemplifies the moral proximity and magnitude of effects aspects of moral intensity, which suggest that the magnitude of the perceived consequences and the feeling of social nearness the individual has to the potential victims will impact an individual's assessment of a given situation, and may even affect moral action (Lincoln & Holmes, 2011). Sebastian described himself as less concerned for the ethical considerations of his project because it was on such a small scale, affecting the magnitude of the potential risk. This sentiment was echoed by Raquel (Class B), who described ethics as being less present in a smaller, more localized environment:

> I think it affects more EPICS teams than others, I think just because all of the teams that I've been on have been like local teams, so like the issues, ethical issues, aren't like a huge deal. But I feel like the teams that deal with like, um . . . maybe like the international teams, you know, like the ones that work with like, um . . . they work with like [third world countries], with like other countries, there are probably a lot more ethical issues to look at than the ones I've been on.

Additionally, many students engaged with the interview process itself as a form of reflection, after which they were able to recognize that ethics was in fact present in their design work. This "revelation" was exemplified by Reid (Class B), as he pondered whether he had anything else to add at the end of his interview:

> I think the biggest thing I realized during this was that the human-centered design… almost directly results in ethical decisions all the time. I never think about that. And I really see it that way. Because every single time—we take ethics surveys all the time for EPICS. And everyone that takes it—not just in [my project team], but everyone else on other teams—always says, "You know, I can't

> really think of a time that we've really had to make an ethical decision." And I'm sure people do it subconsciously, but when you're designing for a person and you're accountable to that person—which you're not necessarily accountable to a person in business—it's easy to just say, "No, forget it, we're going to do this." But you really can't.

This finding suggests that given time and reflection, these students were able to identify instances of ethics in their everyday project design work, suggesting that ethical reflection may be an important component of effective pedagogy in this context.

Although students often did not explicitly recognize ethics in the everyday work of their project teams, ethical orientations emerged from their descriptions of their everyday design work. Additionally, their descriptions of the role and identification of ethical considerations being tied primarily to specific human users or project partners suggests that their ideas about ethics, its role in these design projects and processes, and their responsibilities as student designers, were bounded and inherently linked to explicit interactions or implications to a specific user or project partner. In essence, this finding suggests that ethics in these teams was often directed by and linked to a human-centered orientation, which many students were not able to expand beyond overt or clear links between their everyday work and the specific human stakeholders involved. Based on these findings, it seems that a human-centered orientation toward design builds in considerations of ethics that may not be as explicit or as encouraged in different approaches to design.

It is difficult to distinguish the origin of the human-centered orientation that emerged in these findings. While it is clear that a HCD model of design does encourage

more ethical engagement with design work and processes, it also seems that the EPICS context itself had a significant impact on the students' perceptions about and engagement with their design work (NAE, 2012; Zoltowski et al., 2012). Past literature suggests that organizational Discourses and strong organizational identities can have major impacts on their members' decision-making, prioritization of different types of considerations, and privileging or marginalization of different interests in approaching problems and making decisions (Cheney, 1983; Tracy & Trethewey, 2005). In some cases, strong organizational identities can sway members to privilege the interests of the organization above even their own personal interests (Barker, 1993; Cheney, 1983). In the context of this dissertation study, this may be reflected as ways to understand some of these findings. For example, this organizational preferencing could reflect in some students' articulations that their motives would push them to engage in this design work for the benefit of their various users, even at the expense of, or as a greater motivator than, their personal grade in the class.

Despite its discrete origin, a clear HCD orientation emerged in the students' talk about their design experiences and the way this orientation was utilized as a discursive resource for the students in explaining their motives, priorities, and engagement with their design projects and the role of ethics. These findings suggest that this orientation directed students toward more ethical conduct and ways of understanding and engaging with their design projects and processes. This finding has potentially significant implications, and necessitates further study for a thorough investigation. I plan to continue this study and include participants from outside the EPICS program, who may be operating under different orientations toward design, to examine how the HCD model

might affect approaches to and understandings of design with regards to ethics outside of the EPICS context itself.

CHAPTER 5. DISCUSSION

5.1 Introduction

This dissertation contributes to a communicative understandings of ethics in student engineering design teams as a constitutive process in which project participants make sense of, discuss, and construct individually and in teams their understandings of design and the role of ethical considerations in these projects. This project captured the social nature of design work that is increasingly a feature of scholarship (Bucciarelli, 2010) and elucidated the role and perception of "everyday ethics" (van de Poel & Verbeek, 2006) in engineering design work. The communicative approach builds on these recognitions and provided insight into how ethics and other design priorities are constituted in the everyday organizing and relations in which design work is embedded, following a constructionist approach to organizing (Fairhurst & Putnam, 2004; McPhee & Zaug, 2000). Drawing from qualitative discourse analysis and quantitative social network analysis, I found that ethics seems to be perceived distinctly from other considerations in design work and may be influenced by a human-centered orientation toward design.

5.2 Theoretical and Methodological Contributions

This study contributes in several theoretical and pragmatic ways. First, this dissertation study advanced team communication research and ethics research by using a naturalistic setting, which offered an opportunity to examine team concepts

related to existing teams, rather than relying on team responses to hypothetical scenarios. Similarly, several scholars have investigated teaching interventions for ethical learning outcomes in an engineering education context, notably Davis and Riley (2008), but often relied on hypothetical and "disaster" scenarios, rather than examining ethics *in practice*. Second, this study complements those explorations with a communicative lens, which enabled me to explore how the students responded to an educational format designed to promote ethical principles, the social relations underlying these responses and perceptions, as well as what ethics means to *them* in this context.

5.2.1 Contributions to Team Communication and Ethics Research

This study extends the vast body of literature in small group communication by answering the call to offer a naturalistic look at ethics in team-based work *in practice (*Cheney et al., 2011). Much existing small group communication research relies on experimental and quasi-experimental research designs; this approach has been recognized as limited in some ways when trying to examine team processes specific to existing team processes and their real-world projects (Sullivan et al., 2013). In contrast, this dissertation focused on assessing the real-world experiences of design teams in an engineering education context, relying on observations, reflections on the actual decisions and considerations faced, and the social relations that developed throughout the course of this work. This was an important approach for capturing the emergence of the fluid and subjective nature of ethics that may be dependent on context and that reflects the nature of the interactions in which ethics is embedded.

An additional significant contribution of the research design used in this dissertation was the application of social network analysis to the small group context. This project followed the calls by several network and small group scholars (Katz et al., 2004; Whitbred et al., 2011) to apply network theory to the small group context and probe team-based work phenomena. In combination with the qualitative findings, the social network measures illuminated some of the patterns that emerged surrounding ethical relations on these teams and the distinction between those relations and technical, programmatic, and friendship relations. The application of a social network approach to examining ethics in existing teams contributed to our understanding of the team interactions and relations that underlie ethical reasoning and outcomes in team-based work. The findings illuminated how and why individuals in such teams conceptualize one another as resources for ethical and other design-related considerations and how ethics itself is seen to fit into this work. Although information-seeking behaviors were not examined themselves, this study provided insights into the premises underlying who students perceived as the primary resources for these distinct kinds of knowledge, which would be a precursor to their actually seeking out this guidance. The structuration-based social network approach (Whitbred et al., 2011) allowed me to envision how these interactions and perceptions of relations reflexively shape the ethical environment in which these students operate, contributing both to team climate as well as to the kinds of rules and resources that inform the structures guiding behavior within the EPICS program, giving more insight into the way and significance of how team processes work in this context.

Similarly, much of the research and theory associated with ethics in engineering education rely on scenario-based and hypothetical assessments. Students often find these teaching and learning tools to be unrealistic and difficult to relate to (Kline, 2001; van de Poel & Verbeek, 2006). Over the course of everyday engineering design work, students often do not realize they are engaging in ethical processes at all (Davis & Riley, 2008; van de Poel & Verbeek, 2006). This study provided an examination of how ethics is conceived and handled in everyday practice, utilizing the "everyday ethics" (van de Poel & Verbeek, 2006) approach to probe not how students react to hypotheticals and ethical lessons, but how ethics is manifest itself in the everyday work of team-based design projects. By providing a naturalistic look at how ethics is considered and handled in practice, this dissertation study furthers the "everyday ethics" approach and furthers our understanding of ethics in engineering education.

5.2.2 Contributions to Organizational Communication

The mixed methods approach provides useful insights in both social network and discursive analysis. I argue that by putting these methodologies into conversation with one another, this study was able to more fully interpret and consider the full picture when looking at how team member interactions emerged and how those interactions were constituted. A constructionist approach to conceptualizing communicative relations in engineering design teams relies on the assumption that individuals and groups reflect on their experiences in the organizations in which they have membership and make attributions about those organizations, which often form the basis of action (Fairhurst et al., 2002; Weick, 1979). This study attempted to

prioritize language by utilizing interview texts in combination with other data to explore how ethics and design are discursively constituted. Through the triangulation of data and a careful examination of both the findings and the potential limitations of a discursive approach, I took a measured and careful approach to the two levels of discourse (Potter & Wetherell, 1987), making every effort to avoid the "armchair research" and vague or inappropriate application of discourse analysis to a communicative context that Alvesson and Kärreman (2011) warn against. By pairing a discursive approach with social network theory, I provided rich insight into the structural and communicative aspects of design work on these teams. Additionally, I provided a rich body of data to analyze by conducting in-depth interviews with all but one member of both teams, so that I could draw the perspectives of the complete group comprising these teams and portray the entire landscape of social and communicative interactions.

In considering the social network and discourse approaches in conjunction with one another, I was able to present a view of the complete network and the patterns of communication that emerged around each construct in each class; these findings both enriched and were enriched by the interview findings, which gave the students' perspectives on what those networks of communication meant to *them*, both individually and collectively. Either method would have generated interesting insights on their own, but I argue that the combination of the two made both—and the resulting overall findings of this study—more complex and nuanced.

Specifically, I gained insights into the patterns of communication that emerged at the full team level by using a social network approach, which enabled me

to visualize and analyze the patterns of communication surrounding technical and program competence, friendship, and ethical competence. I was able to compare network measures across the networks as well as compare the different networks within each class to generate insights into the relations surrounding these different relations on these teams.

I gained insight into the constitution of these relations by combining these findings with insights that emerged from the discursive approach. These data interacted in two distinct ways: First, I guided participants through the social network instrument to gain their perspectives on their responses and probe what those relations meant to *them*. Students were able to provide insights into how and why different team members were included or excluded from the different networks, and provided context for those decisions within a design environment. This approach enabled me to gain insight into individual discursive practices and perspectives, as well as compare across the entire sample to uncover some common ways these students were thinking about and assessing one another's competencies. Second, I considered the social network findings in the context of the themes and results generated by a discourse analysis of each individual's complete interview. This allowed me to develop a clearer picture of both the informal patterns of relations that emerge surrounding technical, program friendship, and ethical relations in project-based student design teams, as well as suggesting some of the reasons these informal patterns develop. This dissertation study advances the use of these two approaches together and demonstrates some of the useful insights that can be gained from this combination in organizational communication research, which was able to offer a rich

picture of the discursive practices and the social relations that underlie organizational life and the interrelations between them.

5.3 Theoretical and Practical Implications

Theoretically, the findings lead to additional implications about how teams operate in general and the uses of ethical and human-centered lenses. For instance, students articulated and the EPICS program encourages contact with and deep understandings of potential users not only to design effectively but also to anticipate some of the often unanticipated uses or processes of design outcomes. In these cases, designating ethics in design as embodied, relational, and empathic supplies the language for areas in which communication and engineering education scholars might explore. For instance, the expressions of these design features and the handling of human-centered approaches by participants indicates that there is some element of social identity construction that affects team members and potentially, their developments of their own self and organizational identities. A poststructuralist view of identity views it not as a fixed, internal construct, but rather a constantly evolving conceptualization that forms through competing Discourses and social validation and reinforcement (Tracy & Trethewey, 2005). The concept of a social identity (Tajfel, 1972) situates this identity formation process within the social context, in which an individual acknowledges that he or she belongs to specific social groups in which one shares and shapes elements of the self within groups of socially significant others (Hogg & Terry, 1995). Scholars have argued that organizational membership can encourage or even control social identity formation by offering appealing or advantageous self-categorizations (Alvesson & Robertson, 2006)—for example,

"innovative" and "intellectual" may be appealing self-categorizations within a tech start-up organization, and the institutional forces (or structure, in a structuration approach) may encourage individuals to adopt and begin to mold their own self-identities to better perform or internalize these conceptualizations. The findings in the current study suggest that the human-centered approach implicated in the EPICS program and process may encourage individuals to act—or at least, to discursively construct themselves and position others—in more ethical or socially aware ways which may emphasize this orientation. Given the potential power and control afforded by implicating individual identities in organizational life (Alvesson & Willmott, 2002; Barker, 1993), the implication of individual identity formation in such a program could have potentially significant positive and negative implications, from encouraging the internalization of a more ethical orientation toward design work in the future to overriding an individual's interest and replacing it with the interests of the organization.

Additionally, the structuration-based social network approach offers implications for the use of a structuration approach to illuminate the constitutive processes in a team-based project context and serves as a framework for *how* the program is communicatively constituted. For example, using McPhee and Zaug's (2002) four flows, we can see how complex organizations like the EPICS program and similar engineering education programs can be communicatively constituted, and we can use these insights to point to specific areas of attention for such organizations.

Organizational processes may be distinctly but interrelatedly important to the communicative constitution of these programs. Membership negotiation becomes

especially important in this type of program, in which membership is constantly shifting across semesters. The processes by which students both comprise the membership and form the foundation of the program, while at the same time occupying a transient state with an expectation of termination of that membership, can impact how membership is constituted and what it means in this context, as well as the implications for power and marginalization of temporary (student), permanent (advisors and administrators), and longer-term (returning) members. The way the program and its members communicate and constitute one another would have implications as well for ethics and ethical conduct, including the level of seriousness with which it is considered or expected among different kinds of members. Similarly, the norms and work flows established by organizational self-structuring would impact the way ethics is interwoven throughout or excluded from everyday organizational practices, just as the activity coordination processes in the program would impact the perceptions of organizational goals, identities, and the ethical or non-ethical orientations toward design work.

Additionally, emphasis on the impacts on institutional positioning highlights the program's relationship to other entities, such as project partners and other stakeholder organizations that may be important to the operating and success of the program. This concept may be specifically important to the engineering education context, where most of the members are young engineers who after a set amount of time will leave the program and go to other related organizations. Thus, students can be seen as potential "boundary spanners" who will impact the external identity of the program and the relations between the program and relevant stakeholder programs,

alongside the professors, advisors, and administrators who bridge communication between such institutions.

One of the most pragmatically interesting findings in this dissertation was the overwhelming inability of students to identify and articulate ethical considerations within their own projects. In considering this finding, practical implications for engineering education emerge. These findings offer important insights to engineering educators by promoting better understanding of how ethics is manifest in project-based program contexts, as well as how ethics seems to be identified, attributed, and managed differently from technical and program knowledge. Throughout the analyses provided above, it became clear that there is something about ethics that is being communicatively handled distinctly from other constructs in these teams. This study suggests that engineering educators should be aware of the distinct roles ethics and technical skills play on team-based projects and help students both to understand or to recognize the presence and importance of ethical trust in their teams, as well as to value the different kinds of resources offered by diverse team membership. The conceptualization and manifestation of ethics in these teams suggests that this program has an important impact on the ethical development of its students.

While organizational forces are always a consideration in how organizational members shape their identities and orientations toward their work, EPICS is a uniquely human- and ethics- oriented program within engineering education. As a service-learning program, EPICS prides itself on its success at giving students a community-oriented, real-world experience to prepare them for future careers in engineering (Coyle et al., 2005). The EPICS program has been so successful that a

number of other universities have developed EPICS and EPICS-based programs (NAE, 2012; Zoltowski et al., 2012). Yet even in this environment which emphasizes ethics both in its organizational identity and discourses, as well as practically building it in by offering projects with real community partners and real needs, students still struggled to articulate and name ethical implications of their work.

As was discussed throughout this dissertation, ethical training of engineers is a central concern to engineering educators, future employers, and the governing bodies of the field (ABET, 2013). While there is still much more to learn about this, consideration of the program and findings involved in the current study provide some insights. This study offers both successes and challenges with these efforts. Students were unable to explicitly identify ethical concerns and implications beyond the traditional "disaster" scenarios (Lloyd & Busbey, 2003). However, as the findings showed, they were engaging in their work ethically in their motives, intentions, and descriptions of their work itself, indicating that ethical *practices* are being taught and learned in this context. Thus, while they are not able to name and identify ethical considerations directly, the EPICS program seems to be instilling an ethical orientation toward design and design reasoning.

An initial consideration of this finding may be the pedagogical approach to ethics in these classes. While students may have more exposure to technical and program-related teaching, both in this class and throughout the rest of their engineering curricula, the EPICS program features several formal lessons about ethics, as well as inviting students to participate in a number of ethical surveys and questionnaires. Indeed, given the self-driving nature of these teams, while technical

skills are taught to some extent, they are more often learned "on the job" and modeled by returning or senior team members. Class A held one formal lesson on technical skills related to CAD modeling and Arduino, and Class B held no formal technical lessons during the semester of data collection.

However, all EPICS teams adhere to the human-centered model of design, with posters hung in every lab room and numerous course requirements incorporating HCD thinking and processes in the students' work. This human-centered orientation came out strongly in the students' descriptions of their work on their teams, as was discussed at length in the previous chapter. In fact, many students reflected during their interviews on the uniqueness of the EPICS model in comparison to their other design and engineering classes. Thus, while HCD is a central component of EPICS classes, these findings suggest that students do not perceive it to be supported by the broader environment of engineering education in which they are situated. This analysis suggests that the internalization of the HCD model in EPICS is encouraging more ethical thinking and conduct, despite students' inability to specifically articulate the role of ethics in their work. While this conclusion requires further investigation, the clear emergence of an HCD orientation and the indirect references to ethical considerations and motives suggests that HCD is playing a role in the ethical development of these students.

The findings of this dissertation study may be useful for improving approaches to teaching and assessing ethics in engineering education. Scholars have devoted significant attention to unraveling teaching and assessment of ethics (Davis & Riley, 2008) and social justice (Lucina, Schneider, & Leydens, 2010) in

consideration of a variety of pedagogical approaches. Many efforts focus on an intervention or different approaches taken by a specific instructor, or in a specific class (Davis & Riley, 2008). While many scholars critique and make suggestions for improvement and reform of the social systems that shape and impact these ethical and social justice orientations, the communication approach described in this dissertation study represents a shift in focus to looking at the communicative environment in which students who are developing their own identities and practices learn about and experience engineering. In utilizing a discursive approach, this study elucidates some of the elements of an engineering education program that impact the development of these orientations

The literature suggests that there is a disconnect between engineering education and engineering practice, which is pronounced in the disconnect students articulate in a number of studies (Huff, 2015; Johnson, Leydens, Moskal, Silva, & Fantasky, 2015) between recognition of ethics in *their* specific context or project, and application of those recognitions and the methods that enable them in different context and their other engineering work. This was apparent in this study's findings, in which students would identify the need to consider all stakeholders and their own positionalities when asked directly to talk about ethics in engineering design, but were unable to provide any examples or recognize the presence of those same ethical concerns in relation to their own projects. These ethical orientations toward design did not emerge until the discursive analysis of students' descriptions about their engagement in, and reasoning about, this work, which often contained explicit references to those precise considerations. In considering the significance of this

finding, one possible implication could be the importance of both the service-learning, HCD emphasis informing the practice of engineering design work in the EPICS program, which enables students to learn about human-centered design while actually performing it in their own self-directed projects. It also points to the importance of immersion in a program with such an orientation, which often entices students to participate across a number of semesters.

Several participants mentioned that their approaches to design in other classes and in their internship and other professional opportunities pulls from a human-centered orientation learned in EPICS, such as Danielle's previously discussed account of EPICS "drilling that into our heads." Thus, the combination of a practical element to teaching human-centered and other ethical and social justice implication of engineering with the immersion and repetition of multiple semesters of exposure may be an important key to not only effectively imparting an understanding of ethics in engineering, but also in encouraging students to take these lessons with them and apply them in their future practice. If these orientations are indeed transferrable, this could be a significant opportunity for engineering educators who seek to improve the role of ethics in engineering education pedagogy.

5.4 Limitations

This project has advanced understandings of everyday ethics from a constitutive approach using both discourse and social network analyses. While this dissertation study relied on interviews, observations, and social network surveys, it is fair to say that greater understandings of the interactive constitution of ethics in

design could have been achieved through incorporations of team observations, recorded meetings, photo elicitation, and other methods. Although the use of interviewing and network surveys provides a strong basis for understanding the ethical and design dynamics, one potential limitation for the constitutive nature this study was the investigation of team interactions through interviews. By conducting interviews with every member of each team, I was able to not only analyze each team member's take on their experiences, but also compared differing or similar accounts of team experiences, opinions on the goals and motives of each team, and other team-level perceptions about the project experience. The themes generated from similar accounts and descriptions were useful in generating an overall picture of how these students engaged in and understood team work in these projects. However, a rich exploration of instances of differing accounts, or distinct opinions on team-level constructs, yielded particularly important insights and provided rich grounds for delving into not only how team members viewed the interactions captured by the SNA, but also how a diversity of opinions about those interactions may shape and influence team and individual outcomes.

Additionally, a natural limitation of the methodologies chosen for this study was the inability to examine talk-in-interaction. While SNA can be used to capture informal interactions, discourse analysis applied to individual interviews can only access the individual perspectives and interpretations of team members. Video recording and analysis of the teams engaged in their everyday design work would have enabled me to compare social network *interactions* to team member interactions

in practice, rather than relying on perceptions and relational ties. Videorecordings and their analyses promise to offer an important complement to this study in the future.

Finally, it was challenging to apply social network analysis to a small group context with such a small sample size. While I followed Katz et al. (2004) and Sullivan et al. (2013) in their suggestions for approaching small groups through SNA, more advanced statistical and methodological approaches, coupled with additional data, would enhance this approach in future work. After conducting this study and working with these data, I believe a longitudinal approach would be a productive way to advance these research efforts and apply social network theory to a small group setting.

In reflecting on this dissertation study, I recognize that two central issues seem to be important in understanding this context that were not fully explored. The first is the role of moral intensity, especially with regards to affecting network structural patterns and accounting for different approaches to and constructions of design. This theme came out strongly in the data as an undercurrent of much of the students' talk about and organizing around ethical issues in design work. Going forward, this concept could be incorporated more explicitly into the methodologies and probed more deeply to examine how, specifically, it interacts with ethics and design.

The second was a greater examination of the role of identification and its relationship to group norms and ethical outcomes. These norms would also affect how the team engaged indecision-making and problem solving (Postmes et al, 2001; Reimer et al., 2012). For example, while an in-group/ out-group dynamic emerged as

important in the students' assessment of others and their decision premises in constructing others as viable resources for different constructs, a greater examination of how those dynamics impacted group discussions, and how different team members' contributions were valued, would provide further insight into these decision-making processes and the forces impacting them. While decision-making was not assessed in this dissertation study objectively, students' descriptions of the decision-making processes in which their teams engaged suggests that these feelings of comfort or liking played a role, especially in determining the willingness of team members to suggest ideas and creative solutions and openly share information that may have helped the group (Reimer et al, 2012). Going forward, this will be an important consideration when applying a longitudinal approach to these teams and can help parse out the structuration elements of how these teams evolve and relate.

Additionally, while past literature suggests that friendship may play an important role in design work, the findings generated by this analysis suggest that it may play an even more critical role in design work and ethics. Past research on friendship in organizational contexts suggests that friendship relationships can be important sources of emotional support, instrumental benefits such as informal access to promotions and other experience-advancing opportunities, and other kinds of interpersonal rewards (Markiewicz, Devine, & Kausilas (2000). Additionally, theories of homophily (or the importance of perceptions of similarity to interactions) suggest that perceptions of friendship can affect to whom and for what reasons individuals will approach others (Ibarra, 1993). While this study provided only a one-time snapshot look at the network structures of these teams, friendship relations

could be expected to influence the development of team norms and interactions as the length of time working together as a team increases. The importance of these informal relationships was evident in the findings of this dissertation project. The perception of friendship relations significantly impacted how participants assessed and valued their team members' contributions and knowledge, and helped to shape the ethical team climates in which these teams operated. Friendship relations may be important to the development and perceptions of ethics in these teams as well. In some cases, individuals who were described as seeming to embody ethics were constructed as being more or less of a primary resource for ethical, as well as other kinds of issues. Participants also described individuals with whom they felt closer or more similar as more ethical, regardless of any "evidence" or lack thereof to support these assessments. Perceptions of friendship impacted ethical relations and assessments, as well as influencing the development of team norms and values that guided the team's orientation toward or exclusion of ethical considerations in their projects. If friendship relations really do impact all the other relations that develop on these teams, then it also plays a significant role in the development of group norms, decision-making processes, and the communicative handling and engagement with ethics for these teams.

5.5 Future Directions

While the above contributions have important implications for theoretical and practical advancement of our understanding of ethics in design teams, this study also generated several questions that could be explored in future research. Four particular questions remain as guides for advancing this line of inquiry:

1. What further insights can we gain by applying a social network and discursive approach to understanding organizational communication? This dissertation demonstrated the useful combination of social network and discursive approaches to the context of team-based design projects in an engineering education program. Throughout the course of the analysis it became clear that ethics and design are, like all forms of organizational life, fluid, ever-changing, and context-dependent. In a program like this, while the projects themselves may go on for a number of semesters, the members of the teams shift and change with every semester. Future work could employ a longitudinal approach to this analysis, which would facilitate examination of how the dynamics of the team and their interactions with the project adapt and evolve over time and as they move through different phases of the design process. While the observations and discursive approach provided perspectives of the members and their accounts of the changes they saw as salient in both their team dynamics and their understandings of ethics in their project, a longitudinal social network analysis could enable researchers to envision the changing patterns of relations, as well as to identify the different mechanisms that may predict and explain these evolutions. It may be of particular interest to examine how new members shift into returning members with higher levels of expertise, and how the ethical resources on the projects shift and develop over time.

Given the increasingly fluid and sometimes temporary membership in contemporary organizational life, and the increase in team-based work in organizations, this approach has the potential to be particularly useful beyond this specific context for examining not only how ethics and other values are manifest and

handled communicatively, but also how those manifestations and meanings may change and shift along with the changing member dynamics. This approach promises to allow organizational scholars to probe the highly interdependent nature of the changing patterns of social relations and the communicative constitution of these issues that underlie team-based work, as well as how those relations and constitutions may shape or be shaped by the past and future of the project and team.

2. Must ethics be named to be of value to the design process? This analysis showed that students struggled to explicitly name ethics in their project work, as well as to identify explicitly ethical issues that arose over the course of that work. Many students were able to come up with an example of something ethical that either did or could arise, when pushed. However, in their more general descriptions about their work over the semester, many students appealed indirectly to principles of ethical design work and the fundamental tenets of a human-centered approach. Many also framed their involvement in EPICS in terms of wanting to do good, help others, and serve their communities, suggesting ethical and laudable intentions. A communicative, constitutive approach showed that even when constructs are not explicitly named or acknowledged in talk, they can still occupy an important place in our understanding of the world, our relations with others, and our actions based on these understandings. Future work can probe more deeply into the nature of ethics in design work such as that which was represented in this dissertation study to consider whether ethical work is being done, regardless of the participants' ability to specifically name and identify it. If so, it may be important to consider the value of teaching students ethics in an explicit, named way, or whether there may be

alternative formats for introducing ethical reasoning and processes that generate the same amount of benefit to the design work. This leads us to my third question:

3. Are there specifically identifiable differences in the way ethics is being taught and modeled in these teams, as opposed to technical and programmatic competence?

The goal of this dissertation study was largely to describe and explain an under investigated area of this context; namely, what is happening on these project-based design teams regarding ethics? Future research is needed to further parse out why these different conceptualizations developed, and eventually, how engineering educators can better equip students with the tools to understand and engage with ethics in their teams. More exploration is needed and should include a more thorough investigation of the organizational and programmatic forces that may be shaping student perceptions about ethics in their teams. Future work can build upon this initial investigation to more directly identify and isolate specific factors that may be contributing to the development and handling of ethics on these teams. Researchers may investigate the organizational context, elements of teaching styles and curriculum, and other components of this environment to try to determine if specific educational interventions are more or less effective in instilling an ethical orientation toward design work in students. While several scholars have sought to examine this issue in past literature, notably Davis and Riley (2008), I believe an explicitly communicative approach would be appropriate to build on and enhance these investigations and to better understand the relational and interactive foundations of these educational approaches.

4. How is ethics manifest in talk-in-interaction and daily practice? A communicative approach can be of particular value if researchers are able to observe the design teams in daily interactions to examine how ethics is communicatively constituted over the course of the design work itself. While this study did include extensive observations that provided context and support for the qualitative and quantitative findings, observations and analysis of students engaged in the talk-in-interaction and everyday practice of their work could provide additional insights. Observations could also provide a counterpoint to the perceptions and discursive constitutions discussed in this dissertation study.

5.6 Conclusion

This dissertation study offered a communicative approach for examining engineering design teams that may be particularly useful to engineering education programs, as well as offering insights from the application of this method into the social processes underlying engineering design team work. The social network analysis and qualitative results of this study indicated that technical competence, program knowledge, and ethics are interrelated yet distinct components of design work in an engineering education program. These findings suggest that these elements of design work in an engineering education program were seen differently by members of these teams, and the interactions surrounding them emerge and develop in distinct ways.

Specifically, this study provided insights into the reflexive relationship between the role of ethics in team-based engineering design teams and the communicative structures that emerge in these teams. These findings suggest that

technical and ethical competence are distinct and identifiable in these teams, and participants seemed better equipped to make assessments of technical matters than ethical. These findings illustrate the useful application of social network and discursive approaches to examining team-based work in organizations and uncovering the forces underlying team processes that may impact team members' priorities and understandings of design in this context. Future research in this area can contribute valuable theoretical and practical insights for this important field of research.

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APPENDICES

Appendix A Recruitment Text

Hello! My name is Megan Kenny Feister, I am a Ph.D. student in Organizational Communication. We know a lot about how design teams work, but it's really important for future professionals to work effectively in the team context and for programs like EPICS to understand what is important in helping you get there.

We are studying EPICS teams to see how students talk to each other and interact, and how they handle ethical issues in engineering design work, and we need your help! We are seeking current team members who are 18 years of age or older to participate in this study. The study has two parts: A survey and an interview. The survey requires that you look over a list of all the people in this class and check off people with whom you interact. Because we will be listing the names of people in your class, all class members will be asked if they consent to be included in the roster by returning a paper indicating either "yes" or "no" and their name. Participation in the study will include a survey that will take about 20 minute, and an interview that will take between 30-50 minutes, after which it will be transcribed, coded, and analyzed. Confidentiality will be maintained and your identity will not be disclosed.

Participation in this study is completely voluntary. Your instructors in EPICS will not know whether you participated or not, and you may withdraw from the study at any time during the process. You will receive $15 dollars in compensation for your participation.

Additionally, to do this study right we need complete teams to participate, so in addition to the compensation you will receive for your individual participation, if your complete project team participates you will all be entered in a drawing to receive an additional gift!

We can be extremely flexible with your schedule, so if you would like to participate in this study please contact Megan Kenny Feister at mkenny@purdue.edu or (513) 478-5935 and I will get you set up.

Additionally, you can contact Dr. Carla Zoltowski, Principal Investigator, at (765) 494-3559 or cbz@purdue.edu if you have any questions about the project.

Thank you for considering participating in this study!

Sincerely,

Megan Kenny Feister

Purdue University

Appendix B Recruitment Information Sheet

RESEARCH PARTICIPANT INFORMATION SHEET

Understanding the Constitutive and Social Processes of
Engineering Ethics in Diverse Design Teams

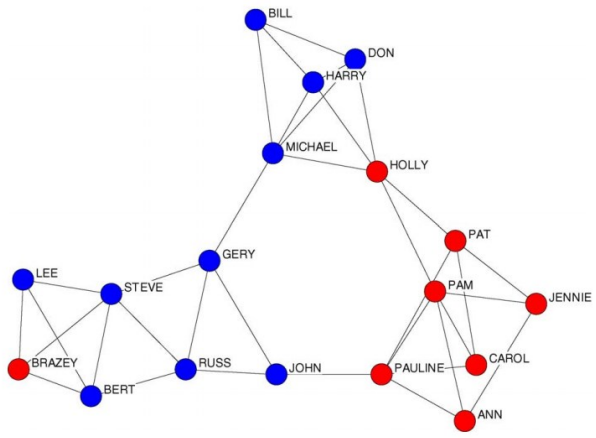
Dr. Carla B. Zoltowski
EPICS
Purdue University

What is the purpose of this study?

This study seeks to understand how students on multidisciplinary engineering design teams understand, engage with and discuss ethics.

What do I have to do?

Specific Procedures: We are conducting a study which will include an interview and completion of a survey to find out who you interact with regularly during the course of your EPICS project. In order to map out who talks to whom, we will need you to give us your permission to include your name on a list of the students in the class so that everyone who participated in our study can indicate who they work with regularly. Once we finish collecting this data, we will use this survey to construct social network maps like this one:



While this map example includes names, we will assign you a pseudonym so that your real name is not included. This consent form is only for permission to include your name on the roster for our study. You will have an opportunity during this semester to participate in the study itself.

Duration of Participation: No time will be required from you, only your consent to have your name included on the roster for this class.

What are the possible risks and benefits for me?

Risks: While no study is without risk, the risks associated with this study are minimal and will not be greater than what you would encounter in everyday life. The greatest potential risk is breach of confidentiality. Safeguards to minimize this risk are discussed in the Confidentiality section of this form.

Benefits: You may not have any direct benefits by participating in this study, but the goal of this research is to understand how multidisciplinary project teams talk to each other and interact, and the relation this has to team ethics. Our findings will help identify the experiences and communication patterns that might encourage ethical team behaviors.

Compensation: No compensation will be given for your agreement to be included in the roster.

Extra Costs to Participate: There is no cost to the participant.

Confidentiality: In order to maintain confidentiality, the information gained from using this roster in our study will only be made available to the other researchers, and no one in the class, including the instructor and your classmates, will be able to see the responses people make to the survey. For the study itself, your name will be removed after we collect all the data, and you will be given a pseudonym for the survey data and any publications. The project's research records may be reviewed by the departments at Purdue University responsible for regulatory and research oversight.

Voluntary Nature of Participation: You do not have to participate in this research project. If you agree to participate you can withdraw your participation at any time without penalty or impact on your grade or standing in the class.

Contact Information: If you have any questions about this research project, you can contact Megan Kenny Feister at (513) 478-5935 or mkenny@purdue.edu or Dr. Carla Zoltowski at (765) 494-3559 or cbz@purdue.edu. If you have concerns about the treatment of research participants, you can contact the Institutional Review Board at Purdue University, Ernest C. Young Hall, Room 1032, 155 S. Grant St., West Lafayette, IN 47907-2114. The phone number for the Board is (765) 494-5942. The email address is irb@purdue.edu.

Appendix C Social Network Survey

Thank you for agreeing to participate in this study! **Please make sure to complete both parts fully, and please complete this before the Design Review.** Please remember you will not receive compensation until both the surveys and the interview are complete. Also, please remember that all of your responses here and during the interview are completely confidential, so no one including your instructors and classmates will know your responses or whether you participated. Thank you for your time, and feel free to contact me at mkfeister@gmail.com with any questions!

Part 1. Please answer the following questions to the best of your ability.

1. Please write your full name, as it would appear on this course registration. (Remember, this identifying information will **not** be shared outside the research team; this is simply to allow me to link your survey to your interview).
2. What is your current age?
3. What year are you at Purdue?
    a. First year
    b. Second year
    c. Third year
    d. Fourth year
    e. Fifth year
    f. Graduate student (non TA)
    g. Teaching assistant- M.A.
    h. Teaching Assistant- Ph.D.
    i. Advisor

4. What specific project are you working on within your EPICS class? (overall project, not your sub-project work)
    a. [list of projects in that class]
5. How long (in semesters) have you been involved in this **or another** project in EPICS?
6. How long (in semesters) have you been involved with **this specific** project in EPICS (not just this class, but this actual project)?
7. What is your major, declared or intended? (Please use your major's official title. If undecided, please write Undecided, and include what majors you are considering).
8. What do you consider to be your ethnic background?
    a. African American or Black
    b. Asian or Pacific Islander
    c. Hispanic
    d. American Indian/ Other Native American
    e. Caucasian (other than Hispanic)
    f. Other (please specify)
9. What nationality do you identify with?
10. Please briefly describe your role on your project team (your "official" role and a short description of what you do).
11. Please briefly describe your project this semester in EPICS. (Describe in lay terms so someone outside EPICS could understand).
12. Please briefly describe where your team is in your project right now (what are you guys focused on at this point in the semester?)

Part 2.

Below is a roster of all the people in your EPICS class who agreed to participate in this study. Please answer the following questions, thinking about your work with them on your EPICS project. This should take about 10 minutes.

Q1. I work with this person regularly (e.g., every class meeting; sometimes outside of class time)

Q2. I can **rely on this person to complete a task he or she agreed to do.**

Q3. I would feel comfortable **sharing my personal problems and difficulties** with this person.

Q4. I can rely on this person to have the **technical competence** needed to get the task done.

Q5. I can rely on this person to have the **project/ EPICS knowledge** needed to get the task done (non-technical).

Q6. I would go to this person if I had a **serious ethical concern** about the project.

Q7. I consider this person a **friend**.

Please select the box below each of the 7 questions for each person on the roster to whom that statement applies.

	Q1. Work with regularly	**Q2.** Complete tasks	**Q3.** Share personal problems/ difficulties	**Q4.** Technical competence	**Q5.**Project/ EPICS competence	**Q6.** Ethical concerns	**Q7.** Friends
Classmate 1							
Classmate 2							
Classmate 3							
Classmate 4							
Classmate 5							
Classmate 6							
Classmate 7							
Classmate 8							
Classmate 9							
Classmate 10							

Classmate 11							
Classmate 12							
Classmate 13							
Classmate 14							
Classmate 15							
Classmate 16							
Classmate 17							
Classmate 18							
Classmate 19							
Classmate 20							
Classmate 21							
Classmate 22							
Classmate 23							
Classmate 24							
Classmate 25							

Are there any other people you feel would fit the above statements who were not listed above? If so, please enter their names, title (to you; e.g., your Project Partner), and which statement they apply to (e.g., Q1, Q3 and Q6).

[Sample: "[Project partner]- Q1, Q2, Q4" or "Project partner- I go to him when I need technical advice."]

Thank you for completing this survey! I will contact you toward the end of the semester to take the second survey and schedule your interview.

If you have any questions, please feel free to contact Megan Kenny Feister at mkfeister@gmail.com.

Appendix D Interview Protocol

Team Interactions & Process:

- **First, tell me about your team**
  - What project you are working on, purpose of the team, how long you have been involved, how many team members
- **Describe your team interactions as a whole.**
  - *Explore whether friendly, seem to care about each other*
  - *Task-focused or project focused or grade focused, or hanging out…?*
- **How would you describe the culture of your team?**
- **What kinds of things are important to or valued by the team?**
  - *Explore HCD versus other models of design*
  - *Is this for your project team, your EPICS team, or EPICS as a whole?*
- **What are your team's priorities?**
  - *Are these shared by all or do different people have different priorities?*
- **Where do you think these values or priorities came from? Why does your team consider them and how did you all learn that they are important in this context?**
  - Does your team have a formal or informal "code of cooperation"?
- **What are expectations your team members have of each other?**
  - How might new members learn about those expectations?
- **Where did that value come from; why do you think it had become so prominent in your thinking**? *[In response to the values like safety or good construction or HCD]*
- **How did the project teams form on your EPICS team?**
  - *E.g., gender, skills, returning members, assigned, proximity, friendship…*
- **Who would you say is your team's project partner?**
- **Who is your team developing this project for?**
  - How often is that considered in the design process?
- **How would you characterize your team interactions with your advisor, your TA, your project partners?**

Individual:

- **What is your role on the team?**
- **How do you feel you contribute to your group?**
- **What are the roles of your team members? (be specific)**
  - **Who has what role; how does each member contribute?**
  - Consider a typical design decision and how people interact then.
- **Do you feel like you are friends with your team mates?**

- **Do you feel you can trust or confide in any of your team mates? What about the professor, advisor, TA?**

Decision-making

- **How and when are decisions made by your team?**
  - **How do those decisions arise?**
- **What kind of decisions are typically made?**
  - **Can you give me some recent examples of design decisions your team has made in the project?**
  - **Can you give me some recent examples of some other decisions your team has made in the project?**
- **Think back on those decisions. Who brought the issue up initially? How was it discussed by your team? Were there initially different opinions about it? How was the decision ultimately made? Think specifically about that scenario.**
  - If a decision was made that someone in your team didn't agree with, how did they respond?
  - If you didn't agree with a decision, how did you respond?
- **What are some conflicts or areas of tension that might come up when your team makes decisions?**
- **If your team faces an issue they aren't sure how to resolve, what do/would you do?**
  - Who do you go to for input? Who organizes the problem-solving process?
  - How do people usually react when these kind of decisions are being made and discussed? Possible follow-up: What is the atmosphere like during those discussions?

Ethical Decision-Making and Climate

- **What does ethics mean to you? Try to define it.**
  - Think about this in terms of you personally, your team, and your profession.
  - **How do you personally make ethical decisions? What do you consider?**
  - **How do you as an engineer (or in design) make ethical decisions? What do/should you consider?**
- **Has your team encountered any ethical issues or considerations?** What happened?
- **If there was a really sticky ethical issue, how do you think your team would respond?**
  - **If no issues, come up with a hypothetical.**

    - Would team members speak up if there was an ethical issue? If so, who would bring these things up?
- **Do you think your team share a common understanding of "right and wrong"?**
    - How do you know that? Do you have a specific incident?
    - Do you discuss ethical issues? Specifically or indirectly?
- **Would you feel comfortable voicing a view different from that of most of your team members?**
    - How do you think others would react to you?
- **What ethical issues do you think your team should contend with now or will have to contend in the future when thinking about your project?**
- **How would you define design? Human-centered design? Are there differences?**

SNA Section

- **For each of the 7 categories, tell me what that statement meant to you, what you were thinking about when you answered it, or give me an example of each.**
- **Probe anomalies or interesting responses in the survey that you prepped beforehand.**

General Wrap-up

- **What kinds of issues did your team consider at the start of the project?**
    - **Probe: Who did you think about, what values seemed to come into play, what did your team value in those decisions?**
- **Does your team seem concerned about professional codes and/or rules/laws?** What about confidentiality agreements?
    - Can you give a specific example?
- **Do you think your team shares a common understanding of design and this project?**
    - **Probe HCD, design priorities, project partner.**
- **Do you think your team thinks about what impact our work will have on the community at large?**
    - Can you give a specific example?
- **Can you think of any specific design decisions or choices your team made that might have had ethical implications?**
- **Do people in your team seem more concerned with personal goals or teams goals?**
    - How do you know that? Do you have a specific incident?

    - If push came to shove, would your teammates make a decision to benefit their grade in the class or the end users of the project?
- **Does your team push you to be a better person? A better engineer (or designer)?**
    - **Do you think you make more or less ethical decisions with your team? Or, does your work on your team seem to have no effect in that area?**
- **Who would you go to in your group if you needed advice/ guidance? Why that person?**
- **Is there a person on the team who you think is more or less ethical? Is there a person you or your teammates might go to if you felt there was an ethical issue?**
    - ***Ask them to rank people or specify in what context they would go to for each***
- **Do you believe your team values the different perspectives (team members, users, etc.)?**
- **Thinking back on all the issues your team has faced, do you think now that any of the decisions your team made might have incorporated ethical considerations? Even on a small scale?**

Is there anything else you can tell me about your work on your EPICS team that relates to engineering ethics?

Can I contact you if we have any further questions?

**Helpful Follow-Ups:

-Can you think of a specific example of that?

-Ask for more specifics about who or how a decision was negotiated.

-Give examples to probe specific micro-ethical implications.

Appendix E Coding Scheme

1. **Design priorities:** This aggregate code contains all responses that indicate the priorities or orientations toward design articulated by a respondent. These codes are specific to the *design*, not team-level orientations (eg. "we all want to make a difference for people."). There are specific facets of this in the sub-codes below, but this code can be used for anything that is not covered by those specifics but still relates to design priorities.
    a. **Description of project**: This code refers to descriptions of the goal, mission, or overview descriptions of the project itself.
    b. **Desirability:** This code refers to descriptions that reference the user's needs, problems, or opportunities for improving certain functionalities or situations. (User focus)
    c. **Feasibility:** This code refers to considerations for the feasibility of a solution or design component, including technical aspects and constraints and program constraints such as time and delivery. ("Engineering" focus)
    d. **Viability:** This code refers to considerations for the economic viability of the product, including marketability, budgetary constraints, etc. ("Business" focus)

2. **Construction of identities**: This code refers to how the respondent or others are said to be constructing and conceptualizing one another including competence (or lack thereof), motives, and traits. There are several sub-codes that refer to specific facets of expertise that may be salient below, but this aggregate code may be used for any allusions to construction of expertise that cannot be categorized by the sub-codes.
    a. **Position of Authority:** This code refers to indications regarding one's position in the group/EPICS/Purdue or other traditional origins of authority. This includes references to specified roles and hierarchical structures.
    b. **Returning Members:** This code refers to references to a person's longevity and previous experience with this project or with EPICS in general. This includes references to a person's understanding or expertise related to EPICS systems, requirements, etc., as well as familiarity with the project itself, project partner, or end user.
    c. **Newcomer:** This code refers to references to a person's position as new or inexperienced, including references to being new to the project itself (regardless of previous EPICS involvement), being a freshman or underclassman, etc.

d. **Certain skills:** This code refers to references to a person's demonstrated or inferred specific skills and abilities (eg. CAD, woodworking, marketing, etc.), including past experience.
e. **Interdisciplinary Premise:** This code refers to descriptions of a person's expertise or credibility that rely on the person's disciplinary membership. This includes references to major, and/or specific classes.
f. **Interpersonal Premise**: This code refers to descriptions of other team members in terms of interpersonal considerations (eg. personality traits, charisma, "liking," feelings of friendship, etc.).
g. **Ethical Premise:** This code refers to indications that a certain person has ethical/moral authority or is sought out for their guidance.

3. **Orientation to experience:** This aggregate code contains responses that indicate a participant's orientation to their experience in this project. The sub-codes below should be used to identify articulations that imply specific decision premises and general orientations. **Contextualizing descriptions or decisions in terms of privileging these contexts or facets of their identity.**
    a. **Identification- Individual:** This code refers to descriptions of a participant's preferencing of their own personal interests above those of the team, project, program, user, etc. This includes descriptions of individual benefits or outcomes; what the participant says about what they will "get out" of this experience.
    b. **Identification- Work group:** This code refers to descriptions of a participant's preferencing the interests of their project team/ EPICS team above individual, program, user, etc.
    c. **Identification- Organizational:** This code refers to descriptions of a participant's preferencing the interests of EPICS or Purdue above those of the individual, project team, user, etc.
    d. **Identification- Occupational:** This code refers to descriptions of a participant's preferencing the interests of engineering above those of the individual, project, program, user, etc.

4. **Ethics:** This is an aggregate code containing all responses that include references to ethics and ethical reasoning. There are specific facets of this in the sub-codes below, but this code can be used for anything that is not covered by those specifics but still sounds like an ethics-related statement.
    a. **Definition of ethics:** This code refers to definitions of ethics or ethical reasoning, either explicit or implied.
    b. **Identification of ethics:** This code refers to a participant's identification of specific issues/ concerns/ experiences as having an element of ethics.
    c. **Moral intensity:** E.g., What they talk about, how much they talk about it, and the language (e.g., this is "really" important, etc.)

5. **Team Work:** This is an aggregate code containing all responses that include references to working on a team and team climate. There are specific facets of this in the sub-codes below, but this code can be used for anything that is not covered by those specifics but still sounds like statement about team work.
    a. **Interdependence- design:** This code refers to indications that the design work is interdependent, collaborative, and/or involves a diversity of perspectives or skills. This code is specific to *design*, rather than general team-level discussions.
    b. **Interdependence- team work:** This code refers to indications that team-based work is interdependent, collaborative, and/ or involves a diversity of perspectives or skills. This code is specific to *team and relational* issues, rather than design-specific discussions.
    c. **Team norms:** This code refers to indications that the team (project or class level) does things a certain way or indications of an established work flow; these utterances may be explicit, or may indicate that which is taken for granted or not explicitly recognized, but guides behavior and decision-making.
    d. **Socialization:** This code refers to descriptions of how new members experience/ adapt to teams and established norms.
    e. **Team Values:** This code refers to general statements about team values, priorities, or orientations (e.g., to user needs, to "the social problem," to grades, to marketability, etc.), and other articulations that indicate team climate and general orientation.
    f. **Leadership- influence:** This code refers to descriptions of the influence of leadership on team relations, decision-making, design, and any other elements of this experience.
    g. **Leadership- attributes:** This code refers to descriptions of the characteristics or behaviors associated with leaders.
    h. **Team conflict:** This code refers to descriptions of tensions or conflict, either explicit or implied through difference of opinion or motivation.
    i. **Understanding of design:** This code refers to definitions of design *and/ or* descriptions that indicate a participant's understanding of or orientation toward design and the design process.
    j. **Demographics:** This code marks demographic information about team composition or individuals.
    k. **Class context:** This code refers to descriptions that emphasize the class aspect of projects. This can include references to assignments, documents, or allusions to an orientation toward the project as a class assignment.
    l. **Roles:** This code refers to descriptions of a team member's or one's own role and contributions to the project and team.

VITA

VITA

Education

Ph.D. Brian Lamb School of Communication. Purdue University. | *August 2015* |
Focus in Organizational Communication
Minor areas: Mixed Research Methods, Public Relations
Committee Members: Dr. Patrice M. Buzzanell (advisor), Dr. Stacey L. Connaughton, Dr. Seungyoon Lee, D. Carla B. Zoltowski,[1] Dr. William Oakes[1, 2]
[1] Engineering Projects in Community Service (EPICS), Purdue University
[2] Engineering Education, Purdue University
Dissertation title: Exploring the Constitutive and Social Processes of Ethics in Multidisciplinary Engineering Design Teams

M.A. Department of Communication. **University of Cincinnati.** | *June 2011* |
Focus in organizational and intercultural communication
Minor areas: Public Relations
Committee Members: Dr. Gail T. Fairhurst (advisor), Dr. Heather M. Zoller, Dr. Suzanne Boys
Master's thesis: "Can I Be Successful Here?" Discursive Construction of Identity and Identification in an Indian Call Center

B.A. Department of Communication, English. Saint Louis University. | *May 2009* |
Major in Communication, English
Minor concentration in Spanish
Cum Laude

Saint Louis University Madrid | *Fall 2007* |
Semester Study Abroad Program
Conversationally fluent in Spanish

Grants

Purdue Research Foundation Dissertation Grant. Co-PIs: P. M. Buzzanell (advisor) H. Sypher (faculty sponsor). "Understanding the Constitutive and Social Processes of Engineering Ethics in Diverse Design Teams." Purdue Dissertation PRF: approximately $18,000. Awarded for 2014-2015 academic year.

NSF REE. Co-PIs: P. M. Buzzanell, W. Oakes, C. Zoltowski. "Understanding the Communicative and Social Processes of Engineering Ethics in Diverse Design Teams." (Awarded, begins August 1, 2014, $300,000; Funding for and *co-written* by Communication Doctoral Candidate, **Megan Kenny Feister**)

Publications

Kenny Feister, M., Zoltowski, C.B., Buzzanell, P.M., Torres, D., & Oakes, W.C. (2015, June). *Exploring the Social Processes of Ethics in Student Engineering Design Teams.* Proceedings from the American Society of Electrical Engineers Annual Conference, Seattle, WA.

Zoltowski, C.B., Buzzanell, P.M., Oakes, W.C., **Kenny Feister, M**., & Torres, D. (2015, June). *Understanding the Communicative and Social Processes of Engineering Ethics in Diverse Design Teams*. Proceedings from the American Society of Electrical Engineers Annual Conference, Seattle, WA.

Dorrance Hall, E., & **Kenny Feister, M.** Navigating emerging adulthood with communication technology. In C. Bruess (Ed.), *Family Communication in an Age of Digital and Social Media*. Peter Lang International. (Accepted, July 2014).

Kenny Feister, M., Zoltowski, C. B., (2014, June). *The Discourse of Design: Examining Students' Perceptions of Design in Multidisciplinary Project Teams.* Proceedings from ASEE Annual Conference, Indianapolis, IN.

Kenny Feister, M., Zoltowski, C. B., Buzzanell, P. M., Oakes, W., & Zhu, Q. (2014, June). *Leadership in Multidisciplinary Project Teams*. Proceedings from ASEE Annual Conference, Indianapolis, IN.

Kenny Feister, M., Zoltowski, C. B., Buzzanell, P. M., Oakes, W., & Zhu, Q. (2014, June). *Understanding team ethical climate through interview data.* Proceedings from ASEE Annual Conference, Indianapolis, IN.

Zhu, Q., Zoltowski, C. B., Buzzanell, P. M., **Kenny Feister, M.**, & Oakes, W. (2014, June). *The Development of an Instrument for Assessing Individual Ethical Decision-Making in Project-based Design Teams: Integrating Quantitative and Qualitative Methods*. Proceedings from ASEE Annual Conference, Indianapolis, IN.

Kenny Feister, M., Zoltowski, C. B., Buzzanell, P. M., & Zhu, Q., Oakes, W. (2014, May). *Making sense of ethics in engineering education: A discursive examination of students' perceptions of work and ethics on multidisciplinary project teams.* Proceedings from IEEE International Symposium on Ethics in Engineering, Science and Technology, Chicago, IL.

Zhu, Q., **Kenny Feister, M.,** Zoltowski, C. B., Buzzanell, P. M., & Oakes, W. C. (2014, May). *Students' perceptions of ethics in a project-based team context: Implications for teaching and assessing ethical reasoning in engineering education.* Proceedings from the Forum on Philosophy, Engineering and Technology, Blacksburg, VA.

Under Review and In Progress

Kenny Feister, M., Buzzanell, P. M., Zoltowski, C. B., Zhu, Q., & Oakes, W. C. Leadership in multidisciplinary project teams: Assessing emergent leadership in an engineering education context. Under review at the *Management Communication Quarterly,* July 2015.

Kenny Feister, M. "Can I be successful here?" Discursive construction of culture and identification in an Indian call center. Under review at the *International Journal of Business Communication*, July 2015.

Zoltowski, C.B., Mead, A., **Kenny Feister, M**., & Buzzanell, P.M., & Oakes, W.C. The development of an instrument for assessing individual ethical decision-making in project-based design teams: integrating quantitative and qualitative methods. Under review at the *Journal of Engineering Education,* August 2015.

Kenny Feister, M. "Welcome to the family": A discursive examination of identity and control in a multinational outsourcing company. To be submitted for publication to *Management Communication Quarterly*, July 2015.

Dorrance Hall, E., & **Kenny Feister, M.** Communication technology and the transition to college: Family relationships, maintenance, and technology use. Under review at the *J*ournal *of Applied Communication Research,* July 2015.

Kenny Feister, M., & Dorrance Hall, E. Negotiating privacy and managing communication technology during the transition to college. To be submitted for publication to *Media Psychology,* August 2015.

Kenny Feister, M. The social design of engineering: Linking social networks to communicative constitution of organizing in engineering design team work. To be submitted for publication to *Journal of Communication*, August 2015.

Kenny Feister, M., Zoltowski, C. B., Buzzanell, P. M., Oakes, W. C., & Zhu, Q. The discourse of design: Examining students' perceptions of design in multidisciplinary project design teams. To be submitted for publication to the *Journal of Engineering Education,* August 2015.

Shorter, S., & **Kenny Feister, M.** "Oh, that's *the Republican*": Negotiating multiple conflicting identities as an African American female Republican. To be submitted for publication to *Journal of Applied Communication Research*, September 2015.

Conference Presentations

Kenny Feister, M., Zoltowski, C.B., Buzzanell, D., & Oakes, W.C. (July, 2015). The *Everyday Ethics of Design: A Social and Communicative Approach.* Presented to the Research in Engineering Education Symposium, Dublin, Ireland.

Feister, M., Buzzanell, P.M., & Zoltowski, C.B. (2015, November). *Understanding the Constitutive and Social Processes of Engineering Ethics in Diverse Design Teams.* To be presented to the National Communication Association Annual Conference, Las Vegas, NV.

Kenny Feister, M. (2014, November). *"Can I Be Successful Here?" Discursive Construction of Identity and Identification in an Indian Call Center.* Presented to the National Communication Association Annual Conference in Chicago, IL.

Kenny Feister, M., Zoltowski, C. B., Buzzanell, P. M., Oakes, W., & Zhu, Q. (2014, October). *Examining the Role of Culture in Assessing Individual Ethical Reasoning on Multidisciplinary Engineering Project Teams.* Presented to Frontiers in Education Conference, Madrid, Spain.

Zhu, Q., Zoltowski, C. B., Buzzanell, P. M., **Kenny Feister, M**., & Oakes, W. (2014, October). *Institutional Culture and Engineering Ethical Reasoning: A Cross-Institutional Study*. Presented to Frontiers in Education conference, Madrid, Spain.

Kenny Feister, M. (2014, September). *Communicating design: Understanding the constitutive and social processes of engineering ethics in diverse design teams*. Presented to the Organizational Communication Mini-Conference, West Lafayette, IN.

Dorrance Hall, E., & **Kenny, M. W**. (2013, November). *Communication Technology and the Transition to College: Family Relationships, Maintenance, and Technology Choice.* Presented to the National Communication Association annual conference, Washington, D. C.

Zoltowski, C., Buzzanell, P., Oakes, W., & **Kenny, M.W**. (2013, October). *A Qualitative Study Exploring Students' Engineering Ethical Reflections and their Use in Instrument Validation*. Presented to the 2013 IEEE Frontiers in Education Conference, Oklahoma City, OK.

Kenny, M. W. (2013, February). Organizational Identification in the Social Network. Presented to the Communication Graduate Student Association annual conference at Purdue University, West Lafayette, IN.

Dorrance Hall, E., & **Kenny, M. W.** (2013, February). *Emergent Communication Technology Use in Family Relationships: A Qualitative Exploration.* Presented at the Communication Graduate Student Association annual conference at Purdue University, West Lafayette. IN.

Kenny, M. W., & Shorter, S. (2012, November). *"Oh,* That's *the Republican": The Discursive Identity of an African American Female Republican.* Presented to the National Communication Association annual conference: Orlando, FL.

Academic Appointments

Graduate Research Assistant. **EPICS and Brian Lamb School of Communication. Purdue University**.
| *08/2014- Present* |

Research project: This study examines students' perceptions of ethics in multidisciplinary design team projects, and seeks to examine the social and communicative processes by which ethics and decision-making emerge on such teams.

- Co-wrote funding applications.
- Co-managed project implementation, inception, and research design.
- Conducted extensive data collection and data analysis.
- Co-developed observation and interview protocols, and independently developed Social Network Analysis survey.
- Collection and analysis of longitudinal social network data.
- Conducted analysis with Atlas.ti qualitative data analysis software and UCINet, a social network analysis software.
- Planned dissemination in the form of papers, conference presentations, and workshops and skill sessions geared toward researchers, educators and students.

Graduate Research Assistant. **EPICS and Brian Lamb School of Communication. Purdue University.**
| *08/2012- Present* |

Research project: This research project was a collaborative effort between four universities (Purdue University, Illinois Institute of Technology, Michigan Technological University and Lehigh University) to develop and validate instruments and understanding of undergraduate students' ethical reasoning abilities and learning within the context of engineering design teams.

- Conducted data collection and data analysis.
- Co-developed observation and interview protocols.
- Co-wrote funding applications.

- Worked with Atlas.ti and NVivo qualitative data analysis software.
- Engaged in dissemination in the form of papers, conference presentations, and workshops and skill sessions geared toward researchers, educators and students.

Graduate Teaching Assistant. Brian Lamb School of Communication. Purdue University.
| *08/2011- present* |

- Received consistently high evaluations from students, which increased each semester.
- Led "stand alone" courses in which I developed and ran the entire course independently.
- Led a large lecture course when the professor unexpectedly went out for maternity leave.
- Taught Honors courses, adapting materials for a more challenging experience.

Graduate Research Assistant. Office of International Admissions, University of Cincinnati
| *07/2010- 7/1/2011* |

Director: Jonathan Weller

- Developed, implemented, and managed a new program, "International Ambassadors," aimed at recruitment, retention and aiding in the admissions process for prospective international students to the university.
- Developed all materials and structure for the program, including hiring and policies, overseeing the 15 Ambassadors directly.
- Facilitated communication with future international students, working closely with university representatives around the world.
- Developed and manage social media campaigns that have contributed to measurably increased applications from key countries.

Research Assistant, University of Cincinnati
| *07/2010-5/1/2011* |

Principle Investigator: John Lynch, Ph.D.
Research project: Research Ethics Pilot Grant, funded by the Cincinnati Clinical and Translational Science Award. Paper Title: "Cutting Corners in Presenting Clinical Research"

- Transcribed and conducted extensive coding of focus groups.
- Worked extensively with NVivo, qualitative data analysis software.
- Assisted with project timeline management.
- Assisted with interpretation of data after conducting coding and establishing inter-rater reliability with fellow researchers.

Semester Conversion Coordinator, University of Cincinnati
| *12/2009-6/2011* |
Supervisor: Joanna Mitro, Ph.D., Associate Dean for Undergraduate Affairs

- Oversaw and coordinated the conversion of courses and department criteria from a quarter system to semesters.
- Created review and approval system in preparation for the 2010 conversion.
- Facilitated communication with course reviewers, department heads and faculty throughout the College of Arts and Sciences.
- Provided feedback to reviewers to help them meet specific conversion criteria provided by the Associate Dean.

Honors and Professional Associations

American Society for Electrical Engineers (ASEE)
Central States Communication Association (CSCA)
Communication Graduate Student Association (CGSA)
Institute of Electrical and Electronics Engineers (IEEE)
International Communication Association (ICA)
National Communication Association (NCA)
Lambda Pi Eta, National Communication Honor Society
Sigma Tau Delta, International English Honor Society
Dean's List, Saint Louis University

Departmental Service and Engagement

Research mentor for new graduate research assistant. Brian Lamb School of Communication. Purdue University.
| ***Fall 2014- Present*** **|**

- Oriented and trained a new Ph.D. student for involvement on NSF REE grant.
- Trained him in data collection and project management.

Mentor for incoming graduate students. Brian Lamb School of Communication. Purdue University.
| ***Fall 2011- Present*** **|**

- Acted as a "buddy" to incoming Ph.D. students, answered questions and helped them arrange housing and other planning for their arrival.
- Helped orient the new students to the program and integrated them with other graduate students.

Departmental Research Activities. Brian Lamb School of Communication. Purdue University.
| ***Fall 2011- Present*** **|**

- Assisted with pilot study instrument development for grant titled "Military Deployment and Families, Conversations about Seeking Help for Mental Health Symptoms. PI: Dr. Steven R. Wilson.
- Numerous peer-reviews for fellow classmates.

Undergraduate Student Mentoring. Brian Lamb School of Communication. Purdue University.
| ***Fall 2011- Present*** **|**

- Wrote Letters of Recommendation for former students.
- Assisted a group of students in turning a class project into a program funded by the University.

Vice President of Technology, Communication Graduate Student Association, Purdue University
| ***2012-2013*** **|**

- Facilitated and developed CGSA activities, including professional development workshops, mentorship programs, and fundraising and promotional efforts.
- Managed departmental listserv, publicized CGSA activities and resources to graduate students and faculty, and revived and expanded social media presence of the School.

Invited Talks and Workshops

Kenny Feister, M. (2015, March). Understanding Ethical Reasoning: EERI and TECS. Invited lecture, COM 496: Negotiating in Everyday Life. Instructor: Patrice M. Buzzanell.

Zoltowski, C. B., Buzzanell, P. M., & **Kenny Feister, M.** (2014, October). *Defining and assessing engineering ethics in an international context.* Special session, presented to Frontiers in Education, Madrid, Spain.

Kenny Feister, M.K., & Zhu, Q. (2014, March). Ethics skill session. EPICS workshop presented to engineering students, EPICS, Purdue University, West Lafayette, IN.

Teaching Experience

Organizational Communication: COM 324
Professor: Dr. Xuimei Zhu

- Constructed materials for and led first two weeks of lectures while the professor was on maternity leave.

- Conducted recitation sessions that are part of the large lecture class.
- Constructed independent materials and assessments for those recitations.
- Supervised students in conducting an organizational communication audit of a local organization of their choice.

Small Group Communication: COM 320

Supervisor: Dr. Torsten Reimer

- Constructed materials, syllabus, and assessments for this independently taught course.
- Developed creative assignments and activities to give students practical engagement with the material.
- Oversaw groups conceiving and implementing a project independently over the semester.
- Assessed, and taught the students to assess, student performances as part of a small group, both against grading criteria and against small group theories.

Presentational Speaking: COM 114

Supervisor: Jane Natt

- Instructed a stand-alone course for 25 students from a variety of majors.
- Instructed 5 regular sections and 2 weekly night sections.
- Met regularly with students and assessed their performance.
- Had weekly meetings with students with special concerns to work on aspects of presentational speaking.

Presentational Speaking: COM 114 Honors section

Supervisor: Jane Natt

- Offered a more intensive presentational speaking curriculum for honors students.
- Worked with students for submission for service learning grant for $1,500.

Graduate Coursework

Organizational Communication

Seminar in Interpretive Approaches to Organizational Communication	Dr. Gail T. Fairhurst	University of Cincinnati Department of Communication
Organizational Communication in an Intercultural Context	Dr. Patrice M. Buzzanell	Purdue University Brian Lamb School of Communication

International Business: Managing Across Cultures	Dr. Lawrence M. Gales	University of Cincinnati College of Business
Negotiation in Organizations	Dr. Gary F. Leuchauer	Purdue University Krannert School of Management
Leadership and Organizations	Dr. Lawrence M. Gales	University of Cincinnati College of Business
Organizational Cultures	Dr. Suzanne Boys	University of Cincinnati Department of Communication
Organizational Communication	Dr. Stacey Connaughton	Purdue University Brian Lamb School of Communication
Rhetoric of Science	Dr. John Lynch	University of Cincinnati Department of Communication
Gender in Organizations	Dr. Patrice Buzzanell	Purdue University Brian Lamb School of Communication

Research Methodology (Mixed Methods)

ANOVA & Regression	Dr. Steve Wilson & Dr. Erina MacGeorge	Purdue University Brian Lamb School of Communication
Communication in Social Networks (Advanced)	Dr. Seungyoon Lee	Purdue University Brian Lamb School of Communication
Social Network Analysis	Dr. Seungyoon Lee	Purdue University Brian Lamb School of Communication
Empirical Research Methods	Dr. Stephen Haas	University of Cincinnati Department of Communication
Descriptive and Experimental Research in Communication	Dr. Seungyoon Lee	Purdue University Brian Lamb School of Communication
Rhetorical Research Methods	Dr. John Lynch	University of Cincinnati Department of Communication
Advanced Qualitative Research Methods in Education	Dr. Nadine Dolby	Purdue University College of Education

Media and Public Relations

Seminar in Strategic Public Relations Management	Dr. Krishnamurthy Sriramesh	Purdue University Brian Lamb School of Communication
Seminar in Mass Communication and Media Theory	Dr. Nancy Jennings	University of Cincinnati Department of Communication
Social Media and Organizing	Dr. Lorraine Kisselburgh	Purdue University Brian Lamb School of Communication
Rhetorical Approaches to Issue Management	Dr. Josh Boyd	Purdue University Brian Lamb School of Communication

Public Relations and Issue Management	Dr. Suzanne Boys	Purdue University Brian Lamb School of Communication

Communication and Rhetorical Theories

Advanced Communication Theory	Dr. Heather M. Zoller	University of Cincinnati Department of Communication
Advanced Interpersonal Communication	Dr. Stephen Haas	University of Cincinnati Department of Communication
Advanced Rhetorical Theory	Dr. Stephen Depoe	University of Cincinnati Department of Communication
Persuasion Theory	Dr. Judith Trent	University of Cincinnati Department of Communication
Rhetoric of Social Movements	Dr. Stephen Depoe	University of Cincinnati Department of Communication
Foundations of Human Inquiry I	Dr. Stacey Connaughton & Dr. Torsten Reimer	Purdue University Brian Lamb School of Communication
Foundations of Human Inquiry II	Dr. Stacey Connaughton	Purdue University Brian Lamb School of Communication

Thesis hours	Dr. Gail Fairhurst	University of Cincinnati Department of Communication
PhD Research hours	Dr. Patrice Buzzanell	Purdue University Brian Lamb School of Communication

Non-Academic Professional Experience

Department Manager, Kings Island, Cincinnati OH | *2002-2010* |

- Tracked business performance and adjusted business model where needed
- Supervised day-to-day department operations, associate and department performance
- Directly managed four Supervisors and over 40 Associates; involved in training employees

VP of Publicity, International Student Federation, Saint Louis University | *2008-2009* |

- Managed and planned events and assisted programs for international students
- Created and distributed all event publicity; extensive use of Photoshop and photo editors
- Organized meetings and events; increased attendance from approx. 23 in 2007 to approx. 150 in 2008

News Section Editor, The University News, Saint Louis University | *2008-2009* |

- Managed writers; responsible for obtaining, editing, and laying out news stories
- Assisted in weekly production of newspaper
- Generated story ideas and contacts for each issue

Security Desk Worker, Saint Louis University | *2005-2009* |

- Worked approximately twenty hours per week
- Developed time management skills
- Enhanced professionalism and responsibility

Irish Dance Teacher, Saint Louis Irish Arts | *2005-2006* |

- Formerly ranked 52nd in the world in age group
- Taught beginner through championship levels, ages 3-21

References

Dr. Patrice M. Buzzanell (Dissertation advisor)
Distinguished Professor of Communication, Engineering Education (Courtesy), Purdue University.
Brian Lamb School of Communication
Purdue University
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Associate Professor of Communication, Purdue University.
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Dr. Gail T. Fairhurst
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Dr. William C. Oakes, Director of EPICS, Purdue University.
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