

## ORIGINAL ARTICLE

# The influence of engineering competition team participation on students' leadership identity development

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## Abstract

**Background:** Engineering competition teams (ECTs) allow college students to learn about and practice leadership within a technical domain, yet we know little about the mechanisms by which leadership development occurs within these teams. This paper explores how ECT participation contributes to students' leadership identity development (LID).

**Purpose:** This paper addresses the following research questions:

RQ1: How does the ECT experience contribute to students' relational LID?

RQ2: What other factors influence ECT participants' LID?

RQ3: Does the ECT experience provide opportunities for LID that are different from those provided by other experiences?

**Design:** This paper reports the second phase of a mixed-methods study. ECT members participated in individual semistructured interviews. Transcripts were analyzed via an interpretivist approach using deductive and constant comparative methods. The analysis employed the LID model as the primary theoretical construct.

**Results:** ECTs contributed to most participants' LID. Factors affecting the extent of development included project complexity, team practices related to the claiming and granting of a leadership identity, positional leadership experience, involvement with other organizations, and preconceptions of leadership. Compared with other experiences, ECTs placed more emphasis on leadership based in expertise. Technical competence was considered a key attribute of ECT leaders.

**Conclusions:** ECTs enhanced the LID of most participants, helping them understand leadership as a relational process. The LID model offers promise for designing engineering leadership development programs.

## KEYWORDS

design competitions, engineering, identity, leadership, teams

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## 1 | INTRODUCTION

College students have the opportunity to engage in a range of activities associated with leadership development (Astin & Astin, 2000; Dugan & Komives, 2007, 2010; Knight & Novoselich, 2017). A popular activity for engineering students is participation on an engineering competition team (ECT), in which they design and build a vehicle, robot, or other devices and engage in interscholastic competitions (Simmons et al., 2018). These teams offer a specialized environment for learning about and practicing leadership within a technical domain (Shuman et al., 2005; Wolfinbarger & Shehab, 2015), yet we know little about the mechanisms by which leadership development occurs within these teams. “Historically, studies of organizations have tended to examine key issues like ‘leadership’ ... as if their meaning were self-evident” (Collinson, 2003, p. 528), and the same observation can be made about leadership research within the field of engineering education. Much of the published literature regarding leadership and the ECT experience has relied on anecdotal evidence (Wankat, 2005), surveys (e.g., Barry et al., 2013; Sánchez-Alejo et al., 2010; Sirianni et al., 2003), and cursory mentions of “leadership” as a benefit of participation (e.g., Sulzbach, 2007; Wankat, 2005) without a deeper examination of the concept. Participation is assumed to contribute to leadership development because the students engage in teamwork, set goals, run meetings, and manage the project. But leadership development does not occur automatically simply as a result of doing leadership-related activities (Day, 2010), and ECTs are no exception (Walden et al., 2015).

Colleges offer a variety of competitive and noncompetitive teaming experiences. Although sports teams are the most widely recognized form of intercollegiate competition, opportunities exist for students to compete in a variety of nonathletic venues as well, such as debate, marching band, and business-plan development. Noncompetitive teams exist within student organizations, project-based courses, and peer support and mentoring groups.

ECTs differ from other collegiate teams in important ways. As a team advisor said, “These competitions are one of the few opportunities for the students to get real hands-on experience constructing something. Being able to conceive, design, fabricate, construct an object, and see it perform in action is an invaluable experience for young engineers” (Wankat, 2005, p. 346). In addition, ECT participants often must raise funds, manage a budget, develop a work schedule, work with administrators and sponsors to obtain resources, and train less-experienced team members. Few other collegiate competition experiences provide the opportunity to develop such a range of leadership-related skills. For example, athletic teams offer competition and teamwork, but the coaches set the requirements and design most of the strategy, while paid staff handle the logistics and administration. The team captain may assist the coach with “establishing team norms and schedules,” but otherwise the captain’s role is that of liaison, communicator, motivator, and exemplar (Dupuis et al., 2006). Marching band is similar: Section leaders are selected by the band directors primarily on the basis of musicianship and work ethic, and their leadership functions consist primarily of communication and motivation (Davison, 2007). Professional and service-oriented student associations provide opportunity for their student leaders to exercise leadership and management functions (Turrentine, 2001), but they typically lack the technical challenges that are the hallmark of engineering teams. And while course-based project teams can address complex technical problems, most lack the inherent motivating factor of a design competition. A student who participates in a curricular project has no choice; students who join competition teams do so voluntarily, often with no tangible reward. The unique nature of engineering competitions makes these teams fruitful ground for the study of student leadership development.

One component of leadership development is leadership identity. In the field of engineering education, leadership research tends to focus on skills and beliefs about leadership; until recently, leadership identity has been largely ignored (Rottmann et al., 2015; Schell & Hughes, 2017). The present paper seeks to augment our understanding of leadership development among collegiate engineering students by exploring how the ECTs contribute to participants’ leadership *identity* development (LID).

The first author (hereafter referred to as “I”) conducted a mixed-methods study of leadership development within two ECTs at a large public university in the United States. The study examined influence relationships among team members, the teams’ social networks as indicators of collective leadership, and team members’ understanding of leadership attributes. This study sought to describe leadership development at the individual level to provide a basis for future research exploring team-level leadership development (Yammarino et al., 2005). Results from this research may be useful in designing a formal program of leadership training, development, and assessment for competition team members and, by extension, the larger engineering student body.

This paper reports a subset of results from the project and builds on the concepts reported previously (Wolfinbarger & Shehab, 2015). At the time of the study, Team A and Team B were this institution’s largest teams. Both teams were co-curricular and largely self-managed, and their membership was drawn from all undergraduate levels. These teams provided opportunities for students to participate over several years. Despite these similarities, the teams differed in composition

and culture. Team A was the most visible ECT on campus at the time of this study. The team was frequently featured in local publications, and its products were prominently displayed in the college's showcase building. Team A's product was complex, requiring members to develop deep technical knowledge and to work interdependently. While the team frequently claimed membership of 40 or more students, 25 were listed on the spring roster during the study year. As has been the case throughout the team's history, the members were primarily white men. There was only one woman on the team. Members emphasized the importance of team commitment, often excluding other extracurricular activities, academic performance, paid employment, and even romantic relationships (Foor, Walden, Trytten, et al., 2013).

Team B was the largest of this institution's ECTs, with 45 members on the spring roster at the time of this study. Team B was rarely mentioned in university press releases, and their products were less visibly displayed. In contrast to Team A's product, Team B's product was simpler, and its construction required less technical knowledge and interdependent work. Members were predominantly white. In contrast to Team A, women constituted approximately 40% of the membership. This level of representation was due in part to the participation requirements set by the national competition organizers, but the team also had a reputation for inclusivity. The team valued commitment but also emphasized fun and friendship. Many of the members, including the officers, were involved in other campus organizations and sometimes simultaneously held leadership positions in more than one group. These differences provided contrasting contexts to explore the effects of ECT participation on students' leadership development.

This paper investigates LID through the following research questions:

RQ1: How does the ECT experience contribute to students' relational LID?

RQ2: What other factors influence ECT participants' LID?

RQ3: Does the ECT experience provide opportunities for LID that are different from those provided by other experiences?

## 2 | BACKGROUND

### 2.1 | Models of leader(ship) identity development

Researchers have advanced several theories of leadership development based on changing conceptions of the self as a leader, a phenomenon variously called leader self-concept, leader identity, or leadership identity (Day et al., 2009; Komives et al., 2005; Lord & Hall, 2005). As with other aspects of identity, leadership identity is socially constructed (DeRue & Ashford, 2010) and not necessarily stable, particularly during the early stages of the developmental process (Day & Sin, 2011). People develop an understanding of themselves as leaders through their interactions with other people in groups. Those who see themselves as leaders will enact behaviors they associate with leadership and will seek "opportunities to practice one's leadership for developmental purposes" (Day & Sin, 2011, p. 547).

The portion of the study described in this paper employs the LID model (Komives et al., 2005, 2006) as its primary theoretical framework. The LID model is based on the relational leadership model (RLM; Komives et al., 2013), which describes leadership at the organizational level. The RLM emphasizes the pursuit of a shared vision and incorporates five elements: inclusivity, empowerment, ethics, purpose, and process. Process—the way a group conducts its business—is "as important as the outcome" (Komives et al., 2013, p. 75).

The LID model describes how college students develop as relational leaders and defines leadership identity as "the cumulative confidence in one's ability to intentionally engage with others to accomplish group objectives" (Komives et al., 2005, p. 608). This model is biased toward collectivistic leadership (Yammarino et al., 2012), holding that students who adopt a relational and process-oriented view of leadership exhibit a more mature leadership identity than those who view leadership in hierarchical terms associated with positions of formal authority. Whereas other models of LID focus on adult developmental processes in general (Day & Sin, 2011) or within the context of professional activity (Lord & Hall, 2005), the LID model starts with early childhood and continues through the collegiate experience. For many people, college coincides with the transition from adolescence to adulthood and is a period of intense personal growth and maturation. College students' identities develop in ways distinct from the development of same-aged people who do not attend college (Chickering & Reisser, 1993). Thus, the LID model's embedding of LID within the college experience is particularly relevant to this project.

Using a grounded-theory approach, Komives et al. (2005, 2006) identified six stages of student leadership development: (1) Awareness, (2) Exploration and Engagement, (3) Leader Identified, (4) Leadership Differentiated, (5) Generativity, and (6) Integration/Synthesis. As students advance through the stages, their understanding moves from leadership as positional to leadership as process, and their associated behaviors become more collaborative and inclusive.

In Stage 1, a child is aware of leaders—parents, teachers, the president—and she understands that she is not a leader. In Stage 2, children learn to work in teams and negotiate relationships with peers. High-school students generally occupy Stage 3, the “Leader Identified” stage. They believe that leaders and followers have distinct roles and responsibilities. The status of “leader” or “follower” is defined by a person’s position in a group. Some students will accept leadership roles during this stage; others will stay firmly in the follower camp.

The typical college student matriculates with a Stage 3 identity. As students progress through their college years, their leadership identities also tend to progress—although this is not guaranteed. To move from Stage 3 (the Leader Identified stage) to Stage 4 (the Leadership Differentiated stage), a student must recognize that leadership is a process of moving the group toward its goals and that any group member can lead. During the transition, a student’s understanding of self in relation to others shifts. While people in Stage 3 may see themselves as operating either independently or dependently, according to the situation and their own positional role, students at more mature stages see their relationship with others as one of interdependence. The transition between Stages 3 and 4 is particularly important and designated as the Key Transition. Students experiencing the Key Transition are beginning to see themselves as interdependent with others and to recognize that the ability to exercise leadership is not contingent on a person’s position within an organization. They are ready to engage in shared leadership processes.

When students “develop a new belief that leadership can come from anywhere in the group” and “develop comfort leading as an active member,” they have entered Stage 4, Leadership Differentiated. Students at this stage often exhibit excellent relational skills, but they may “struggle to define [relational behaviors] as leadership” (Komives et al., 2006, p. 405). As students become more confident in their own leadership abilities, they enter Stage 5, Generativity. This name reflects the creative nature of a maturing leadership identity. Stage 5 students see themselves as leaders, and they mentor others in developing leadership skills. Organizational sustainability is important, and students work to improve internal group processes for the benefit of future members. They also actively assess and improve their leadership skills and understand the importance of learning from others. At Stage 6, Integration/Synthesis, students possess a secure self-identity as a leader and believe that they can exercise leadership and work with others to effect change in a wide variety of situations regardless of position. Rather than seeing leadership as an achievement, Stage 6 students consider it to be “a lifelong developmental process.”

There are several challenges to applying the model (Komives et al., 2009), most notably the recursive nature of identity processes. Students may operate at one leadership identity stage but talk about leadership at another. Students may simultaneously exhibit behaviors and understandings at more than one stage. Students may experience rapid periods of development where they seem to skip a stage. And students may recycle through some stages as they encounter new situations. These are common characteristics of stage models (Ibarra et al., 2010; King, 1994; Perry, 1981) and reflect the complex nature of human development.

## 2.2 | Leadership identities within the engineering context

Within the engineering profession, interest in leadership beyond traditional conceptions of engineering management is growing. The US National Academy of Engineering (2004), the Canadian Engineering Leadership Forum (2009), and Engineers Canada (2012) have called for increased attention to the leadership development of engineering students. The American Society for Engineering Education added its Engineering Leadership Development Division in 2013 to encourage research in the field. A number of engineering schools offer curricular or co-curricular leadership programs (Palmer et al., 2016). “Leadership” is now explicitly mentioned in the accreditation criteria for US engineering programs (ABET, 2018). And yet, leadership in the engineering context is not well defined or understood (Knight & Novoselich, 2017).

One key to understanding leadership within engineering may lie in understanding how (and whether) engineers see themselves as leaders. Rottmann et al. (2015) maintained that “legitimacy of the [engineering leadership] field depends on engineers recognizing themselves as members of a leadership profession” (p. 351). In other words, engineers must develop an “engineering leadership” identity. While researchers have previously examined the development of an engineer identity (e.g., Buse et al., 2013; Foor et al., 2007; Stevens et al., 2008; Tonso, 2006a, 2006b, 2014) and a leadership identity (see Ibarra et al., 2010, for a review of the literature), only recently have attempts been made to integrate the two. Researchers at the University of Toronto linked the concepts with their grounded-theory study (Rottmann et al., 2015) and a follow-up survey study (Reeve et al., 2015) of practicing engineers at two Canadian firms. They found that working engineers’ leadership identities could be grouped into three orientations: technical mastery,

collaborative optimization, and organizational innovation. Although engineers in the sample “resisted the idea of leadership” per se (Rottmann et al., 2015, p. 356), they were comfortable associating themselves and exemplary engineers at their organizations with the three engineering leadership orientations.

An NSF-funded project to develop a model of engineering LID among college students is underway at Montana State University (Schell & Hughes, 2017). The Montana State framework combines the LID model discussed above with a community of practice model (Lave & Wenger, 1991). Early results suggest that engineering students may experience conflict between a leadership identity and an engineer identity (Beigel et al., 2019), concurrent with the working engineers’ attitudes reported in the Toronto studies.

The present paper reports research performed before the publication of the Toronto and Montana State studies; my research considered the development of a leadership identity among engineering students but did not seek to identify a specific “engineering leadership identity.” Nonetheless, the findings augment the current understanding and may contribute to a formal definition of engineering leadership identity.

### 3 | DESIGN

This mixed-methods study was conducted in two phases. As reported previously (Wolfinbarger & Shehab, 2015), in the first phase, attendees at mid-fall meetings of Team A and Team B responded to a questionnaire regarding team processes and influential team members. During the second phase, influential team members participated in individual, recorded, semistructured interviews exploring the team experience and their leadership development journeys. This paper reports a subset of results from the second phase.

Because engineering students are developing their technical expertise, they must rely on collaborative learning and the sharing of knowledge to produce a quality product. Consequently, I approached this study with the idea that ECTs would benefit by exercising leadership from a collectivistic and process-oriented standpoint, and I employed theoretical frameworks that incorporated this view (see Yammarino et al., 2012, for an in-depth review). Despite my bias, I engaged in the project as an explorer. My goal was not to support a proposition. Instead, I sought to determine *what* engineering students understood about leadership and *how* team participation influenced that understanding and their LID. I acknowledge that by interviewing the students about their leadership experiences, the students and I participated in creating a new reality. The interviewed students’ leadership identities may have progressed simply as a result of participating in the study (Komives et al., 2006).

### 4 | METHODOLOGY

Quantitative methods predominate in engineering education research regarding leadership. To fully understand leadership development processes of engineering students, more qualitative investigations are needed. Bryman (2004) observed that qualitative studies tend to reveal more functional leadership behaviors, such as resource allocation and communicating information, than do quantitative studies, which often ask participants to rate leaders on transformational behaviors, such as vision, charisma, and inspiration. Furthermore, when people are asked to *talk* about leadership, they tend to speak in practical terms, emphasizing task accomplishment, communication, integrity, and trust. Interview participants can express their implicit leadership theories, helping researchers understand “what people actually mean when they attribute actions to leadership” (Bresnen, 1995, p. 498).

This portion of the project employed narrative analysis techniques (Klenke, 2008) to explore the participants’ individual perspectives. My point of view was interpretivist. Recognizing the existence of multiple realities, my goal was to provide meaning to the participants’ stories. Interpretivism allowed me to use theory to inform the analysis, providing more structure than would have been permitted within a constructivist framework but avoiding the tight constraints imposed by a positivistic, hypothesis-driven method. Interview questions incorporated modern leadership theories such as shared leadership (Carson et al., 2007), functional leadership (Fleishman et al., 1991), team leadership (Burke et al., 2006; Salas et al., 2005), and the LID model (Komives et al., 2005, 2006). Using multiple frameworks as lenses to interpret the students’ interview responses, I compared and contrasted these realities to build a robust picture of team members’ individual and collective views about leadership and ECT (Walther et al., 2017).

I chose the teams to be investigated and attended their meetings to recruit participants, so I knew which students were members of which teams. I was acquainted with one participant before beginning the research. Although

I acknowledge the possibility of perceived power differences related to my age and position as a researcher, nothing in the data suggested that students' responses were affected.

Trustworthiness was established by ensuring that the findings were “generalizable to theoretical propositions” (Yin, 2014, p. 21). For this portion of the analysis, I relied primarily on the LID model but also considered collectivistic leadership theories mentioned above. To ensure fidelity (Klenke, 2008), I corroborated the participants' accounts, sometimes by asking a participant to discuss an event that had been related by a different respondent. I also iteratively compared and contrasted participants' comments within each interview. If the participant made a statement that appeared to coincide with a particular theoretical viewpoint, I looked for additional statements in support of or counter to that statement. By using this type of procedural validation (Walther et al., 2017), I could be satisfied that the conclusions had emerged from the data, rather than the data being forced to fit a theory.

## 4.1 | Participants

Participants for the interview portion of the study reported here (Phase 2) were identified via a social network influence measure, indegree centrality, captured in Phase 1 (Wolfenbarger & Shehab, 2015). A person with high indegree influences many other group members. Indegree centrality is a normalized measure used to compare different-sized groups (Wasserman & Faust, 1994). Team members identified as influential and receiving an indegree centrality score in the top half of their team were invited to be interviewed. The use of network centrality as a selection tool allowed me to identify students who were likely to exercise leadership behaviors even if they did not hold an office. First-year members listed as influential were also invited, regardless of indegree score. Additional potential interviewees were nominated by the team captains and/or were mentioned by team members during interviews.

In total, 14 students, all engineering majors, participated in individual recorded semistructured interviews. Four were women; the others were men. One identified as Hispanic, one as Asian American, and two as Native American. Thirteen were pursuing a bachelor's degree, and one was in graduate school.

Although several nonpositional leaders were identified and invited to participate in the interview phase, almost all those who agreed to be interviewed were officers. Of the 25 members on the spring Team A roster, 13 were invited to be interviewed. Six members participated in the interview; all were returning members and most were officers. Of the 45 members on the spring Team B roster, 11 were invited to be interviewed. Eight members, including two first-year members and six officers, participated in the interview. None of the first-year team members were in their first year of college. The level of ECT experience was similar for both groups, ranging from 6 months to 5 years. None of the Team A participants had experience with other ECTs. Within Team B, one student had briefly participated in another ECT.

## 4.2 | Interview protocol

### 4.2.1 | Interview questions

The interview questions were grouped into four categories: Teamwork within the Engineering Competition Team, Individual Perceptions of Leadership and Teamwork, Leadership Development within the Team, and Individual Contributions to the Team. The full interview protocol is available as an online supplement associated with this article. Questions in the first category, *Teamwork within the Engineering Competition Team*, addressed the team's purpose, goal, and structure, as well as team member interactions. In the second category, *Individual Perceptions of Leadership and Teamwork*, questions were designed to elicit information that would indicate the respondent's developmental stage within the LID model and to reveal leadership behaviors exercised by the respondent. The third category, *Leadership Development within the Team*, included two specific and critical questions. First, the respondent was asked to identify the leaders on the team. The intent was twofold: to corroborate the list of influential team members identified via the Phase 1 questionnaire, and to determine whether the interviewee recognized nonpositional leaders—that is, members of the team who behaved as leaders even though they did not hold a specified office. For each team member named, the respondent was asked, “What makes this person a leader?” This open question allowed the respondent to reveal, unprompted, the attributes they associated with leadership. The final category, *Individual Contributions to the Team*, connected the team experience with the respondent's view of leadership and provided further insight into the

respondent's LID stage and leadership behaviors. The most important questions in this section asked, "Do you view yourself as a leader on the team" and "What has your experience on the team taught you about leadership?"

A modified, shorter set of interview questions was developed for the first-year members. New members were asked if they had been a part of the team's goal-setting discussions, if they felt comfortable speaking up in meetings, and how the veteran team members communicated with and coached the new members.

Students' responses throughout interviews were considered as evidence for LID stage identification. Questions written specifically to aid in assessing LID included the following:

- What do you think leadership is? How has that changed over the years?
- Other than [team], what groups are you involved in?
- In general, do others consider you a leader? How do you know?
- Have you had any particular leadership training? Tell me about that.
- Who are the leaders on [team]?
- [For each person mentioned in the previous answer] What makes this person a leader, in your opinion?
- How do you contribute to the team? Think beyond your particular job/role.
- You mentioned earlier that others [consider/do not consider] you a leader. Do you view yourself as a leader on the team? What makes you [not] a leader?
- What has your experience on the team taught you about leadership?
- Describe a situation within [team] where you applied leadership training, or applied some knowledge you had gained from previous experience.

#### 4.2.2 | Interview procedure

With one exception, interviews took place in January and February, approximately the midpoint of the competition year for both teams. One Team B member was interviewed in June, a few months after the competition.

Before the interview, each participant completed a questionnaire regarding previous ECT experience, academic majors, family educational background, and demographics. Those who had not answered the Phase 1 questionnaire were given the opportunity to do so; all agreed. Participants were paid \$25 via deposit to their university dining card accounts.

Interview durations ranged from 50 to 120 min, the majority of which lasted approximately 90 min, and audio was digitally recorded. During the interviews, participants were encouraged to tell stories and elaborate upon the experiences they mentioned. Follow-up questions were phrased neutrally, in an effort to avoid suggesting "correct" responses. Occasionally, participants were reminded that the interviewer was interested in learning how they understood leadership, not in evaluating their performance as leaders.

### 4.3 | Data reduction and analysis

Transcriptions and analyses were performed using NVivo 10 for Windows. The data set included almost 17 h of interviews, which produced approximately 200 single-spaced typed pages. Coding employed both structured and inductive procedures. A limited set of a priori codes was established, including a code for each interview question, for each category and stage of the LID model, for indicators of shared purpose, social support, and voice (Carson et al., 2007), and umbrella codes for "Leadership Behaviors" and "Leadership Characteristics." The umbrella categories were analyzed for emergent themes, which were then compared with existing definitions of leadership and leader behavior found in the literature (Bass, 1985; Burke et al., 2006; Burns, 1978; Carson et al., 2007; Fleishman et al., 1991; Judge et al., 2004; Morgeson et al., 2010; Pearce & Conger, 2003; Yammarino et al., 2012). Coding began with a structured approach, following the codes established a priori. This was followed by several iterations of open coding. Word frequency counts were also employed to identify emergent themes.

The application of functional and collectivistic leadership theories allowed me to consider a broad range of behaviors as "leadership" and facilitated the identification of each student's LID stage. For example, behaviors such as consideration, coaching, mutual performance monitoring, and empowerment are relational (Burke et al., 2006), as are providing social support and encouraging participative decision-making (Carson et al., 2007). Frequent mentions of

such behaviors provided evidence of an interdependent leadership identity. Similarly, the exercise of certain task-oriented behaviors such as establishing effective information-sharing and decision-making processes for the group can foster the type of supportive environment (Carson et al., 2007; Hackman, 2002) promoted by students at a mature LID stage. Combining these frameworks with the LID model allowed me to use “multiple theoretical lenses” (Walther et al., 2017, p. 398) to support the identification of each participant’s LID stage.

Interview responses were iteratively compared with the LID stage descriptions. While each student’s stage was primarily determined via analysis of his or her own statements, the interviewees’ descriptions of their own behaviors and beliefs were corroborated with statements made by their teammates to build a more complete picture of each participant’s development. A conservative stance toward stage identification was adopted, honoring the model’s bias toward relational and collective leadership. If a student did not express thoughts and describe behaviors consistent with an understanding of leadership as an interdependent, shared process not restricted to positional roles, that student’s leadership identity was considered no higher than Stage 3.

Two transcripts were also independently coded and analyzed by a co-author. The second rater coded only for the LID stage and was given a copy of the model and the a priori codes relevant to the LID. These transcripts were selected for validation because the participants’ responses did not easily map into the LID model. While the second rater’s results verified the initial analysis, questions about one student’s classification remained. This student provided many examples of her current thinking that fit into a wide range of stages, and sometimes she contradicted herself. The final determination was made by simplifying the analytical frame (Walther et al., 2017). Under the LID model, a student’s view of the self in relation to others moves from dependence (Stages 1 and 2) to interdependence (Stages 4–6). Students in Stage 3 and the Key Transition may view themselves as either dependent or independent, with those in transition exhibiting movement toward an interdependent understanding of leadership. Instead of looking at stage-level details, I considered comments reflecting dependent, independent, and interdependent thinking. In the final analysis, I could see that while this student understood interdependent behavior to be important to leadership, she herself was not ready to fully adopt interdependent practices. I was, therefore, satisfied with the original assessment, which placed her in the Key Transition between Stages 3 and 4.

## 5 | LIMITATIONS

As with all research, this study has limitations. First, this project was neither longitudinal nor observational. Each participant was interviewed only once, and all data were collected through questionnaires and interviews. To assess development over time, inferences had to be made. Future work regarding LID within ECT should be conducted over several years and would benefit from the type of embedded ethnography performed by Tonso in her exploration of engineering identity (2006a, 2006b).

Second, as one astute reviewer noted, this paper ignores the effects of both race and gender on LID. This was a deliberate decision made during the design of the study. These and other teams at this institution were already the subject of other studies regarding gender and race (Foor, Walden, Shehab, et al., 2013; Trytten et al., 2015; Walden et al., 2015) so I chose to concentrate on other aspects of the ECT experience. In fact, I deliberately did not ask any questions about gender or race beyond those included in the demographic questionnaire. As a result, respondents did not explicitly comment on race or ethnicity at all, and only one respondent, a woman, briefly discussed gender in relation to her experience. In retrospect, this attempt to separate the impact of race and gender from other aspects of the ECT experience weakened the study. If I were conducting this project today and not several years ago, I would take more care to consider the impacts of these factors. Specifically, I would include relevant questions on interpersonal interactions, expectations of leaders, and leader emergence and selection.

While it would be possible to conduct a post hoc analysis for gendered or racialized expectations and behaviors, discussing such findings in this paper would compromise participants’ confidentiality. The ECT community at this institution was small, largely white, and predominantly male. Anonymizing the responses required obscuring demographic and certain other details, particularly because I used direct quotes and discussed events known to many of the participants. Furthermore, the limited number of women and non-white participants in the sample would make assessments based on race and gender tenuous. As the questions were not designed to elicit information about the experiences of minoritized students, I discourage readers from drawing conclusions about any differential effects on LID.



## 6 | FINDINGS

Responses revealed that the ECT experience benefited students' LID. Of the 12 participants who had been on the team longer than 1 year, only one remained at Stage 3. Four were experiencing the Key Transition between Stages 3 and 4, two were in Stage 4, one was transitioning between Stages 4 and 5, two were in Stage 5, and two had reached Stage 6 (Figure 1). Several students were able to clearly describe the specific contributions of both ECT and other experiences to their development as leaders. Shamir and Eilam (2005) also found that those who expressed a well-articulated narrative exhibited a greater degree of leadership maturity than those who struggled to tell their stories.

The range of influence of the ECT experience is shown through the students' stories. For this paper, I chose to profile six students representing various stages of the LID model. Quotations from interviews illustrate the findings. Some statements have been lightly edited. Ellipses indicate omitted words, and square brackets indicate words added or replaced for clarity or anonymity. Care was taken to protect participants' anonymity. All names are pseudonyms, and pronouns do not necessarily correspond to a participant's gender identification. Some additional identifying details were also changed. Therefore, the reader should avoid drawing inferences about gender or participation in activities other than ECT.

The profiled students exhibit the range of leadership identity stages common among college students, according to the LID model. Their stories show how ECT can affect LID (RQ1), shed light on the influences of other experiences on this development (RQ2), and provide examples of opportunities for LID within ECT that are different from those provided by other experiences (RQ3). These students were chosen for profiling because of their high influence levels within their respective teams and for the rich descriptions provided in their interviews. Connor, the Scout, occupied Stage 6. Mark, the Coordinator, and Luke, the Collaborator, represented different manifestations of Stage 5, Generativity. Tom, the Liaison, exemplified Stage 4, Leadership Differentiated. Their profiles show that ECT participation can promote growth in LID. Two profiles, however, reveal that the positive effect of ECT is not universal. These participants, both senior-level students with significant team and positional role experience, had not become interdependent leaders. Danna, the Reluctant Leader, was experiencing the Key Transition between Stages 3 and 4, and Patrick, the Big Man, occupied Stage 3.

The chosen nicknames are interpretive and characterize the leadership behaviors and perspectives expressed in the interviews. For example, Connor's identity had expanded during his time on ECT, but he still saw the lessons learned from scouting as important to his leadership practice. Connor's boundary-spanning activities also corresponded with Ancona and Caldwell's (1988) definition of scouting within work groups, which includes gathering information and resources from external sources. Patrick's nickname, the Big Man, denotes arrogance and sensitivity to rank, both of which were evident in his interviews. The nicknames are not intended as general types for categorizing engineering student leaders.

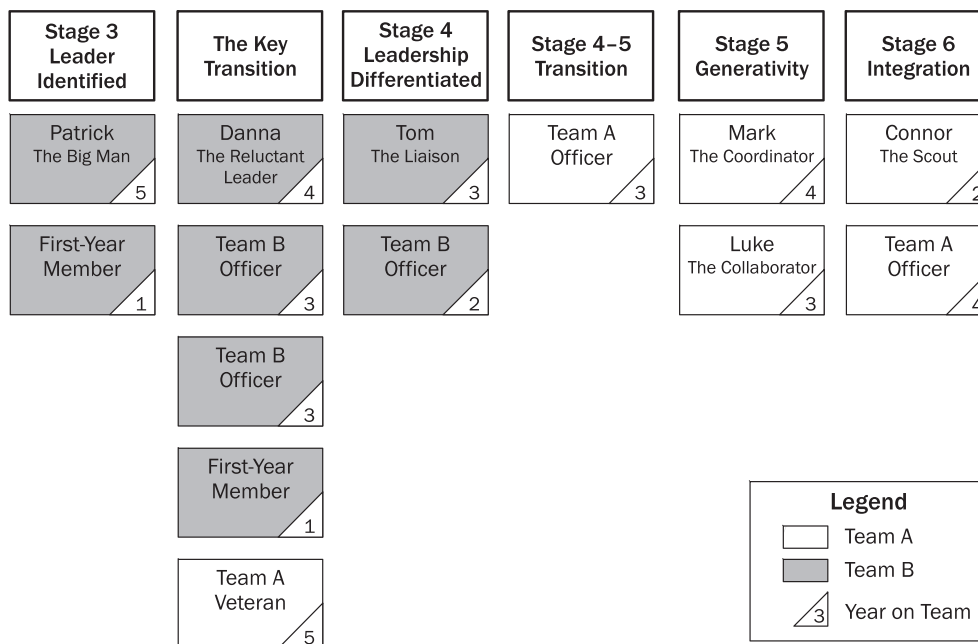


FIGURE 1 Leadership identity development stages of interviewed engineering competition team members

## 6.1 | Connor, the Scout

### 6.1.1 | RQ1: Contribution of ECT to relational LID

At the time of the interview, Connor, the Scout, exhibited clear markers of a Stage 6 leadership identity (Integration; see Figure 1). Although he believed some attributes of leaders, such as a willingness to take initiative, to be innate, he saw leadership as a developmental journey—“something that I’m good at ... and can be better at, developing skills.” He had developed self-confidence and a sense of credibility as a leader: “I know exactly how I’m going to do it and things that need to be done.” He understood the complexity of his organization and had considered ways to span boundaries with other groups, such as “working with the business college” and visiting teams at nearby universities. And he understood how to work with others to accomplish change.

Connor’s responses provided evidence of his having moved through Stages 4 and 5 during his time in college. He had matriculated with a Stage 4 leadership identity and a “get it done” approach; he credited the competition team with developing better relational leadership skills and an understanding of leadership as a developmental process. He understood how to work in a group, recognized “that you don’t have to be in a designated role to be a leader,” and understood the importance of trusting teammates.

Connor joined Team A during his sophomore year and was named an officer within a few months. According to Connor, Team A recognized that leadership could be exercised by anyone on the team: “I set out on the team to be a [technical] guy ... and apparently ... people thought that I was ... leading in the right direction ... [and they] elevated me to a designated role.” He became committed to sustaining the organization, an element of Stage 5. He recalled the time immediately after a national competition at the end of his first season, when the team realized that the seniors were graduating and taking some knowledge with them: “We realized it was just us, and we have to figure out how to make this happen .... I knew that the team wasn’t organized in the way that it needed to be, and that’s where I stepped in ... and they elected me captain, and I kinda took that as an incentive, you know, I used that as leverage to change some of the team management style.” This desire to lead change was not always appreciated. “Resistance [to change] is something I battled with quite a bit .... The [seniors] obviously want to see their year do well .... If you even suggest anything that takes away from this year’s [product], then it’s anarchy. One of the things that we’re doing is looking ahead to [next year’s product]. Everyone knows that there needs to be a lot of changes .... To the seniors, that’s ridiculous because there’s time to do that later—we’ve got a [product] to build now.” Connor also expressed a desire to grow team membership so that responsibilities could be distributed among more people and the business and technical functions could be separated. “I’d love to see starting a business side such that business is done over here and engineering is done over here .... And then to come back in three, five, ten years and see the team with some business guys running it, you know, that’s something that I did.”

Connor not only exercised relational leadership qualities such as coaching and visioning but could recognize these qualities in others, another element of Stage 5 leadership: “Luke, I’d say he’s a coach. He’s a good role model, he’s a motivator, he leads by example, and he communicates, actually coaching someone how to do things, coaching someone how to run a machine, ... having patience with them .... Whenever he’s teaching you, you listen.” Mark “can lead a meeting well, he has a lot of experience on the team, he has good oversight of the [product] .... To have that vision at the end, that’s a very important leadership quality, because sometimes you have to make that tough decision along the way that other people might not see the vision at the end.”

### 6.1.2 | RQ2: Other influences on LID

Connor had grown as a leader through his ECT experience. But what else influenced this development? Connor had considerable precollegiate leadership experience: leadership workshops, co-owning a small service business, and scouting, and these activities promoted his development through Stages 3 and 4. He learned about goal-setting during a junior-high workshop, but he did not think highly of such workshops: “A lot of it I felt like was teaching [people who were] already leaders how to be better leaders .... I don’t think I got much value out of them.” Connor believed that scouting had been most influential to his leadership education: “When it comes to practical leadership, ... any leadership qualities I have, I would attribute to [scouting].”

### 6.1.3 | RQ3: Distinctive contributions of ECT to LID

Although he already saw himself as a leader when he started college, Connor's time with Team A had made a considerable impact. He contrasted the effects of scouting and ECT. Through scouting, he had learned about "the logistics of leadership"—planning and project management. He had exercised Stage 4 behaviors as he practiced leadership in peer relationships, but the scouting experience was primarily transactional: "Whenever they had [the culminating] project you helped them, and when you had [the culminating] project they helped you." The engineering team, on the other hand, required more attention to "people, their motives, tactfulness ... Definitely the number one thing [I learned] is people skills .... Previous leadership roles, I probably never even thought about that stuff."

Connor learned that the ECT project required true collaboration and the extended commitment of an interdependent group. As he described it, "We really don't know what we're doing .... Not one of us could build [this product] by ourselves." Although his experiences as a team officer had been stressful, Connor had fully internalized a leadership identity (Stage 6) and envisioned himself continuing as a leader in his future career: "I think it's just in my nature ... to run the project .... No question about it, if I'm working at a company, then I'll be managing of some sort, whether I like it or not."

## 6.2 | Mark, the Coordinator

### 6.2.1 | RQ1: Contribution of ECT to relational LID

The interview with Mark, the Coordinator, provided several indicators of the influence of ECT on LID. Mark had been "involved in a lot of things" in high school. This is common among Stage 2 students, who are often engaged in "diverse contexts" (Komives et al., 2006, p. 404). By the time he entered college, he was moving into Stage 3 and narrowing his interests. Because he "wasn't able to just hang onto something, truly call it my own" in high school, he decided to choose one co-curricular activity in college. At the time of the interview several years later, Mark had a Stage 5 identity, that of a Generative leader. Declaring that he was not a "natural-born leader," Mark explained how the variety of situations he experienced through ECT had helped him develop both interpersonal and project management skills. Having devoted all his undergraduate years to Team A, he clearly had a passion for the team, and he developed others in a manner consistent with Stage 5 characteristics. He saw his role on Team A as "the voice of reason with the design process ... [and holding] other people accountable." He expressed concern for his teammates, helped others meet their objectives, and spent time mentoring new members.

Like Connor, Mark saw the ECT experience as particularly helpful with regard to relational behaviors. He learned how to be patient, assertive, and emotionally controlled. He learned to collaborate and to "lean on others' strengths," an important element of Stage 4 and evidence of an interdependent view of leadership. Through ECT, he said, "I've developed a lot ... as a leader, because of my exposure [to] situations ... [and] different types of people ... I would have never had to deal with [otherwise]."

Mark recognized leadership as a collaborative process, further evidence of his Stage 5 identity. One of three team executives, Mark described the triad as sharing leadership: "There's not a specific hierarchy .... We're all just in charge of specific areas." One executive, he said, "has a lot of confidence in other people, which is a good quality in a sense because if you're not confident in other people, how can you trust people to get anything done?" The captain, Connor, "communicates well with everyone .... There's no secrets with him. You know what he's doing at all times. Which is a good quality ... in that position." Like Connor, he believed that exercising leadership preceded the attainment of an office. "I feel like everyone who's in a leadership position was put there because ... they're already basically a leader on the team .... Without a title they'd probably be doing the exact same thing."

### 6.2.2 | RQ3: Distinctive contributions of ECT to LID

Mark found it easy to describe the contributions of the ECT experience to his development and could contrast the lessons with his learnings from high-school organizations. For example, leader selection differed. In high-school band, "you had to apply for a leadership position and then you would get it .... [The band director] would pick ... the best players .... Looking back, I don't think specifically that's what a good leader is, but maybe for that context it is."

In contrast, members of Team A selected their own leaders based on multiple factors. Hard work was particularly important: “You know, everyone thinks ... that one person is representative of the team or whatever, and that’s the leader. But I think usually how you get that position is because you’re working the hardest out of everyone .... In the past I always thought a leader was a person, a face, but really to get that position [on the team] you have to be really working hard.” That said, hard work was not the only indicator of leadership for Mark: “A leader isn’t someone who’s supposed to do everything. They’re supposed to motivate other people to do things and lead other people up. So you’re supposed to build other people up and be able to get a lot of people working together. As a leader, it’s not your job to be doing everyone else’s job. It’s your job to make sure everyone’s doing their job.” This emphasis on developing others indicates that Mark had moved from Stage 4, where one understands how to work effectively as a member of an interdependent team, to Stage 5, where a leader can teach others how to do this.

Compared with other collegiate experiences, Mark believed that the complexity of ECT provided extensive opportunities for leadership development. The engineering project’s technical focus meant that ECT leadership “is a lot different than just being a leader in a club .... Being on a competition team adds a lot of value to your education, to your leadership education I think .... I wish there was more opportunities for people to be in the very technical project like [this] team .... It’s one of the most complicated things you can get involved with, and I wish more people could do it.” This type of reflection is indicative of a Generative leadership identity, one that is concerned with the development of others and the sustainability of the organization. Looking to the future, Mark said, “The college ... should evaluate how they can invest more in that kind of stuff. That’s what I will push for when I’m an alumni.”

## 6.3 | Luke, the Collaborator

### 6.3.1 | RQ1: Contribution of ECT to relational LID

Of all the students interviewed, Luke, the Collaborator, best articulated the contribution of ECT participation to the development of a relational leadership identity. He was one of the few participants to strongly articulate a collectivistic, relational view of leadership, and his interview provided the clearest description of the marked effects that immersion in ECT can have on LID. As he explained, “Leadership is not about one person. It’s much more a group effort than one person being a leader.”

Luke entered college as a declared follower and recalled a characteristic Stage 2 identity: “I never saw myself as a leader in high school,” he explained. “I was always a guy that was fine with being told what to do.” Once he was asked to start coaching younger team members, his self-image changed from contented follower to collaborative leader. The interview occurred during the middle of his third year on the team. Luke was by this time operating at Stage 5, having become a recognized team leader, particularly for his coaching skills and cooperative attitude.

As one teammate explained, Luke “is great at teaching people how to do things .... [He] remembers that whenever we were new, we didn’t know how to do anything.” Coaching new team members was Luke’s first leadership experience and was an inflection point in his LID: “This year [they told me] you need to mentor a couple of guys ... and I’ve never done that before, I have no idea what I’m doing.” Luke’s understanding of leadership changed as a result. “How I looked at it in years past is, [a person] leads the team because he knows how to do everything. That’s not necessarily the case. He leads the team because he’s good at communicating, he’s good at taking advice, he’s good at being open-minded.”

Luke expressed a willingness to listen to other members of the team, including new team members. “I’ve been telling [them] lately, don’t be afraid to say anything because we will definitely listen to you .... We can’t afford not to listen to good ideas.” He explained how he puts this approach into practice. “I was showing [a new member] how to use the machine, and he mentioned to me ... why don’t you do it this way? It seems like it will save five or ten minutes. And I said, that’s a good idea.” He explained that getting “new members more involved in decisions” was a new objective for the team. “We’re trying to give them more of a role than they’ve had in the past.” Luke’s openness to others’ ideas and focus on team learning are characteristics of the Generative leadership identity stage. He understood leadership as a fluid process rather than a status to be attained. “It’s not about knowing everything; it’s admitting that you don’t know everything .... [Teammates] could potentially be leading you in certain areas and you’d be leading them in certain areas.” Luke also expressed an understanding of leadership as a collaborative influence process: “[Being asked for advice] is every bit as much of a leader as knowing what to do. It’s being able to give your advice and say, this is the direction I want to go, and now the choice is up to [the group].”

Several of Luke's comments indicated that he was in the later part of Stage 5, ready to transition to Stage 6. He recognized his credibility with team members, saying that is “why they see me as a leader, they respect me enough to ask my opinion and advice.” He engaged in reflection and expressed a vision for the future. Describing conversations he had had with Connor and Mark, he said, “I would like to think, and [the three of us] have talked about this, the system that we've put in place as far as the hierarchy of the team and what they're doing with new members and how we pass along information, when we come back in five years we can easily say we've been a top five team for those five years.”

### 6.3.2 | RQ2: Other influences on LID

Although the team was Luke's only collegiate extracurricular activity, it was not the only influence on his LID. He had also learned about leadership through a professional development course, and he was able to connect this learning to team experiences. “For about a month and a half, it talked about leadership .... I could look at things we were doing on the team ... and say, we're doing that a lot on the team.” The course had helped Luke learn a leadership vocabulary to apply to his actions, an example of a Stage 4 activity. A guest lecturer “talked a lot about empowering as opposed to just communicating. So it's not about, how are you doing on this goal? It's, what can I do to help you with the goal?” In applying this advice, Luke exhibited Stage 5 characteristics of developing others and promoting team learning. “If ... I know you're struggling in this area, I'm not going to dog you for it; I'm going to help out.”

## 6.4 | Tom, the Liaison

While Connor, Mark, and Luke's leadership identities were fairly easy to elucidate, the leadership identity of Tom, the Liaison, was complex. Like some of the students in the original LID study (Komives et al., 2005, 2006), he operated at a higher stage (5) than his expressed identity (3, 4) would suggest. His actions looked like those of a Stage 5 leader, but he did not realize that his excellent relational skills were true indicators of leadership. This internal conflict is characteristic of a Stage 4 leadership identity.

### 6.4.1 | RQ1: Contribution of ECT to relational LID

Tom expressed commitment to a relational approach, similar to that described by Luke, and explained that Team B focused on relationships: “We want to create a team environment where everyone's opinion matters .... We [are] building a relationship [with new members] from the start .... We want [the team] to be inclusive.” This approach helped the team build its leadership pipeline and is an example of Stage 5 behavior. As Tom explained, “The freshmen (sic) are the future and we want to be able to build them for two years before they take leadership.” Passion and commitment to a vision were important determinants of leader selection within the team. “Sometimes it's not even the person that we think's most qualified, it's the person we think really wants it the most .... Do you have ideas that you're passionate about? Are you willing to put in the effort to win the team over on these ideas? Because that's really what it is. You have to be able to be like, I have this vision and I am willing to work to get this vision into reality.” This description also hinted at a Stage 5 leadership identity.

Within ECT, Tom identified boundary-spanning as his primary leadership contribution, an assessment of Tom that other Team B members also expressed in their interviews. An officer, Tom acted as a bridge between the captain and the advisor, particularly when the team believed the advisor was overstepping his bounds: “[The advisor] is a little bit intimidating, and so I'm very much one who doesn't shy from confrontation .... [Sometimes] he'll come and stomp on [the captain's] toes without realizing it. And I'll [tell him], you can't undermine [the captain] in front of the team .... If you have an issue ... talk to us one-on-one.” This, too, is an example of Stage 5 behavior, as Tom responded to a meaning-maker, the team advisor, in a mature and reasonable fashion.

With so much evidence of Stage 5 behavior, why was Tom identified as having a Stage 4 leadership identity? Recall that a leadership identity is by definition a self-conception. While Tom actively participated in multiple student organizations and held several offices simultaneously, he did not consider himself a leader. When asked if others considered him to be a leader he replied, in a questioning tone, “I guess so? Everyone comes to me with the stuff they want to take to the captain. So I guess I'm the through-person, I don't know. I don't think of myself that way.” Intrigued by the

mismatch between Tom's self-perception and his leadership behaviors as described by himself and others, I probed further: "So you don't think of yourself as a leader, and yet you're an officer in multiple organizations." He replied, "I don't. I'm very much of a person-to-person .... I can make a difference in one person's life." This emphasis on personal relationships and the hesitancy in describing this behavior as leadership are characteristics of a Stage 4 leadership identity (Komives et al., 2006).

Tom's Stage 4 status was further evidenced by his deference to Team B's captain and his concern for following established team processes. One of the captain's duties is ordering materials. To ensure timely delivery, this must be accomplished early in the fall. Because Tom possessed a more thorough knowledge of the project timeline than the captain, he sent frequent reminder emails. When the captain procrastinated, Tom did not feel empowered to handle the problem himself. Asked if he could have done something differently, Tom said, "Not without going behind [the captain's] back .... I thought that would undermine [the captain] and hurt the team." Tom considered the delay a "learning experience .... Next year, I guarantee you we'll have it done earlier. Because it's super stressful right now."

#### 6.4.2 | RQ2: Other influences on LID

Tom's leadership education started early, at home, and continued through his high-school years. Tom cited his large family as the most influential source of precollegiate leadership development, particularly regarding assertiveness, negotiation, communication, and supportiveness. He had found the lessons about communication particularly useful on the team. "It's all about communication. Growing up [in a big family] you have to be able to explicitly say what you want and how you need help getting there. Because if you don't do it, if you don't explicitly state it, then you're not going to get it .... People can't read your mind."

Student council provided an additional venue for the development of leadership skills. In addition to serving as a representative throughout high school, Tom was a member of the organizing committee when his school hosted the state student council convention. Tom gained experience in recruiting event participants, a skill he later applied to Team B. "[Promoting the convention required] reaching out to schools ... and pushing it. And so through that I was able to not be deterred from calling people [to help with Team B activities] tons and tons and tons of times." These experiences suggest that Tom had entered college with a Stage 3 identity.

In college, Tom's extensive participation in student organizations helped him learn a number of skills. As with Team B, boundary-spanning was a common activity. In his position with a technical organization, "I talk to companies and schedule times for when they're coming." As a national officer for a cultural affinity group, "I get to hear all of [our] region's problems and take it to Nationals and say, listen, this is what we're having issues with." And in his role with a college-wide engineering organization, he had honed his skills in logistics and event planning.

#### 6.4.3 | RQ3: Distinctive contributions of ECT to LID

Given Tom's involvement with so many different organizations, it was difficult to extract the influence of Team B itself. But the interview provided some clues. Team B, said Tom, was fun and friendly, unlike some other organizations. "You don't dread going to meetings even though meetings are annoying .... I'm at meetings all the time and most of them I hate going to, and I know that it shows. But Team B ... I don't mind going to the meetings because I know that all the friends are going to be there." Being on the team had helped Tom see how strong relationships could be forged through work: "Yeah, we're going to get stuff done but it's also, this is time we get to hang out together."

ECT also provided a setting where nonpositional leadership was valued. Among the Team B leaders Tom identified, one did "not have a position .... [Breonna is] the floater, helps everyone out." Tom cited "her availability to be there for people" and her ability to "make the other person feel comfortable" as evidence of her leadership, a surprising observation since Tom did not recognize similar behavior as leadership in himself.

Team B's leader selection process helped foster some relational practices, such as collaboration. "If there's an area that more than one person wants to be in charge of, then they're in charge of it together. They have to collaborate with each other. And that's something I really like because it forces communication. Even though they might have differing views on what they want, you have to come to something because if not, we're going to be at stalemate for the whole thing."

Despite these positive influences on his LID, other aspects of the ECT experience may have hindered Tom's advancement. Although he had claimed that passion and vision were more important than technical ability when

selecting leaders, he cited his own lack of experience with an important production material as one reason for not considering himself a leader in the ECT context. “I have assets that are used, but I really don’t see myself as a leader on the team. I don’t think my [technical] skills are probably the most valuable. Like I really wish I knew more about [that material] because I feel like that’s a huge asset to the team. And so that’s something that I’m trying to dabble with to learn more about so that I can be a bigger role on the team.” He identified the team leaders as those with relevant technical skills, even if, like Breonna, they lacked a leadership position. “She knows what’s going on and she has the knowledge behind it to back it up.”

Although Team B had a relational atmosphere, its process of choosing team leaders and its emphasis on hierarchy may have constrained Tom’s opportunity to develop an interdependent view of leadership. Rising seniors, he said “automatically get first preference on captain,” who is selected by the outgoing captain(s). “The captains will kind of look around and say, I see potential in him ... and they’ll start mentoring that person to take over when he or she leaves.” The team also expected the captain to be the primary communicator and delegator of work, and failed to take action even when it should have been apparent that they were behind schedule: “Our captain doesn’t pass information down to us very well .... We were scrambling at the last minute to finally get things done when had we have known, we would have been able to do it better. And so that’s where the real disconnect is. It’s kind of like she’s over here, and the leads are here, and everyone else is over here.” Tom was aware of these tasks “because last year I was best friends with both captains,” and yet he did not feel empowered to take charge. “I would always be sending [the captain] email reminders, hey this needs to be done soon, and hey the rules are coming out this week, and hey this is happening. We need to get this done.” In Stage 4 fashion, he was attempting to influence the captain while maintaining the team processes and seeking his own “fit within the organization” (Komives et al., 2006, p. 405).

Tom’s experiences contrasted with those of two other Team B members: Danna, the Reluctant Leader; and Patrick, the Big Man. Although both Danna and Patrick had been on Team B for several years and held executive positions, the leadership identity of both remained at Stage Three, but for markedly different reasons.

## 6.5 | Danna, the Reluctant Leader

Danna, the Reluctant Leader, occupied the Key Transition between Stage 3 and Stage 4 identities. At the time of the interview, she was in her fourth year on the team and had just completed her first semester as captain. Her leadership identity was almost a mirror image of Tom’s: She sometimes spoke in terms consistent with Stage 5 (Generative), but her actions were more indicative of Stage 3 (Leader Identified). Throughout the interview, Danna’s speech alternated between positional (Stage 3) and processual (Stages 4 and 5) views of leadership, but she never expressed an understanding of the interdependent nature of leadership that underpins the latter stages of relational leadership identity. She still talked in Leader Identified, hierarchical terms, as evidenced by statements such as “the captain ... makes all the decisions,” “your people,” and “people below them,” and she had difficulties with delegation, a common feature of Stage 3.

Danna was reluctant to call herself a leader. While she acknowledged that other people considered her a leader, she refrained from claiming that identity. “I try and not perceive myself a leader. I try and think I’m just another member of the team who has a little more experience.” When asked to explain the drawback to seeing herself as a leader, she replied, “[I would be] setting myself apart .... The thing I was most afraid of when I started college ... was the leader is above me and I’m afraid to approach him .... Well, I don’t know if anybody on the team will see me that way if I become ... a full-out leader [but] there might be somebody like me on the team that does see me as that, and I don’t want that to happen.”

Danna’s leadership identity stage was difficult to elucidate; for this reason, her interview was one of the two selected for evaluation by a second rater. One comment in particular illustrates this difficulty. When asked to define leadership, Danna expressed thinking characteristic of Stage 3 (a hierarchical view, motivation, delegation, and getting things done), Stage 4 (concern with team processes, seeking to support others), and Stage 5 (team learning, preparing others for succession). In the following quote, Stage 3 talk is indicated by bold type, Stage 4 by italics, and Stage 5 by underlining. “I think what makes a good leader is **while you can make sure your team gets what they need to done, you always try to push them forward**, *get them involved in making sure they know why they’re doing the things that they’re doing. Making sure they are happy with the things they are doing. And while we are making progress towards our goal, they’re learning along the way. They’re getting that experience that they need.*”

Danna’s comments relating to RQ1 and 3 were so thoroughly intertwined that these questions are addressed in the same section, following the discussion of RQ2.

### 6.5.1 | RQ2: Other influences on LID

Although she had joined ECT during her first year of college and was captain of Team B, Danna spent much of the interview talking about another large university organization (not associated with engineering) that she had joined the following year. Danna's primary extracurricular collegiate activity was the nonengineering organization. "[It] takes over my life in the fall and everything I do is related to that," she explained.

Danna's interview suggests that she began college at Stage 2. Although she had participated in extracurricular activities and clubs during both high school and college, Danna saw herself as a follower. "In high school I wasn't a very outgoing person. So I always saw [a] leader as just somebody who was able to get the word out .... They were always higher than me. I was afraid to approach them .... While they were always very nice, friendly people, it was my insecurity about leadership. Come to college, started off that way."

She credited her participation with the nonengineering group as a turning point in her LID. "You really got to know [the positional leaders] .... [I realized] they're not unapproachable. And that's when I started to think maybe I can be a leader. Maybe my quiet side will contribute to making that wall break down for other people." Through this experience, Danna began the transition from a follower identity to a leader identity. "I was a junior when I tried out for leadership. It was only my second year in [the group] ... and I made the leadership team." This organization gave Danna the courage to try leadership and reinforced her understanding of trust, teambuilding, and the responsibility to exhibit personal excellence as a member of a group. "It's getting [the leadership candidates] involved, getting them incorporated in it and making sure they feel connected with each other. And that's the leadership training they try and impart on us."

### 6.5.2 | RQ1: Contribution of ECT to relational LID, and RQ3: Distinctive contributions of ECT to LID

The ECT experience furthered her development. Unlike Connor, who had learned management skills prior to college, Danna said that the team had helped her learn "the management side of leadership." As ECT captain, she was responsible for "making sure everything gets done ... the paperwork, the fundraising, ... thinking about money ..." and boundary-spanning, "talking to people outside of the university."

ECT also showed Danna the importance of coaching younger members and of thinking about the leadership pipeline. Danna belatedly realized that her focus on the other organization had resulted in a gap in her training for the Team B captaincy, and she was working to help her likely successor avoid a similar fate. "I'm making sure [he] knows ... all the information ... so he can get the experience." She also saw the effects of limited training on other team roles: "I'm trying to make sure we have more people up for [all] the jobs."

While Danna had not developed an interdependent view of leadership, she did appreciate the interdependent nature of the ECT project itself. In this way, ECT differed from her other major collegiate activity, where people "stick to their [assigned groups]." On the engineering team, collaboration was common and subteam membership was more fluid. A member's subteam assignment, he said "really doesn't matter. I don't have it set in stone, well why aren't you doing this right now, you're supposed to be on the design team, they're upstairs working on the design, why are you down in the [shop]? They don't mind helping other people out. They'll show up whenever I ask them to, they're excited to learn, ... they're excited to work together." According to the LID model, this ability to "see the collective whole" and "value others and their involvement" (Komives et al., 2006, p. 405) are elements of Stage 4 and indicate that Danna was making progress toward a relational leadership identity.

Progress was further evidenced by Danna's ability to reflect on her own mistakes and connect those mistakes to leadership lessons. "Next year they'll know to start earlier. They'll know to choose a different path." Danna acknowledged her failings and described how she had attempted to compensate by relying on others' strengths. "I've asked [the secretary] ... to do anything he can to make sure I get him the information to send out to the team." Although she still talked in hierarchical terms and expressed reluctance to claim her identity as a leader, engaging in this reflective activity—associated most strongly with Stage 5—suggested that she was ready to advance to the interdependent phase of LID.

Although she held the chief executive position, Danna's fear of being called a leader may have prevented her from acting like a leader and practicing leadership skills. To move through the Key Transition, Danna needed to fully relinquish her fear. She needed to accept that the captain could not do it all and trust others to do their jobs.



## 6.6 | Patrick, the Big Man

Danna was not the only longtime member of Team B to occupy Stage 3 at the time of the interview. Patrick, the Big Man, was one of the most intriguing participants. He had held the largest number of collegiate organizational leadership positions of all participants but had experienced the least degree of LID.

### 6.6.1 | RQ1: Contribution of ECT to relational LID

Patrick's story shows that extensive involvement in ECT does not necessarily foster the development of a relational leadership identity. At the time of the interview, he was a senior and the president of a large organization. Yet his leadership identity remained at Stage 3, Leader Identified. He emphasized the leader–follower distinction and equated official positions with leadership. When asked to name leaders on Team B, he replied, “Obviously the leads [officers] are generally going to be leaders.” He quoted his long list of positional roles as evidence that others considered him to be a leader. And while some respondents recognized that certain team members were, in the words of Connor the Scout, “leading in the right direction” before they received a title, Patrick viewed behaviors such as “show[ing] up regularly, [taking] on tasks, and get[ting] work done” as *precursors* to leadership: “That's how all leaders are developed within our organization. People who actually show up and do things will ultimately become leaders.”

Patrick talked about his accomplishments as an officer in various organizations, but he focused on his own efforts and rarely discussed working through others to accomplish group goals. He expressed little confidence in Team B members' ability to set goals and make decisions: “If you can't get people together and tell them what the goal is and when we're going to do things, it simply won't happen .... The goals of the team are always going to be set by the captain.” He doubted the members' internal motivation: “Most ... show up to do something fun or to put something on their résumé. It's the captain and maybe a few of the leads who really have to actually push if we want to really reach for something.”

### 6.6.2 | RQ2: Other influences on LID

Patrick was skeptical of formal leadership training, and he attributed most of his leadership education to observation. “I've never really had a good leadership workshop. I've just been watching over people.” He had taken an engineering leadership course, but he did not find it enlightening. When asked if he had applied lessons from that class to the team, he responded, “Not really .... I remember a lecture on not setting people up to fail .... I remember thinking about it at one point in relationship to [Team B] .... Obviously I've forgotten a lot of what I learned in that class.”

Despite being stalled at the Leader Identified stage, Patrick had experienced some development through his varied experiences. Patrick described how his ideas had changed during his collegiate career: “When I was young I always thought leaders were kind of, either really charismatic people, or people who got tapped, got lucky. But I really came to understand just how much goes into it.”

### 6.6.3 | RQ3: Distinctive contributions of ECT to LID

Patrick credited his Team B experience with some important lessons, particularly the experience of completing a large technical project. “[Being on an engineering competition team has] taught me that to be a leader people have to have faith in what you're doing. You have to show that you've thought things out, you have a plan, and that you're going to execute it. You're not just going to attempt to do something. You're actually going to *do* something.” He also believed that Team B had helped him develop communication skills. “I've found that communication is the heart of all leadership .... There's the whole side of motivating people and then actually communicating to get them to do it.” However, another statement revealed that Patrick understood communication as unidirectional messaging rather than a collaborative exchange: “Most communication I guess is going to be from the captain to the other members.” These conceptions provided further evidence of his Stage 3 identity.

Like Mark the Coordinator and Connor the Scout, Patrick understood the challenges of having responsibility without true authority. “It surprises me, how difficult it actually is to coordinate people. Aside from their skills, their level of effort. I guess it's primarily an issue here because all the stuff is volunteer. You can't just fire people.” Patrick

seemed more comfortable with delegation than Danna, the Reluctant Leader, but he did not fully trust others to fulfill their commitments. When tasks went undone, he blamed other students' lack of dedication rather than his own management skills. He found it difficult to identify "team player[s] .... I've had so many people say they'll do things, and at the last minute I'll ask them if it's done, and it's not."

Patrick's numerous leadership positions may have actually hindered his LID. Recall that he cited his own elective offices as evidence of his identity as a leader. A person whose organization makes progress may attribute that success to their own behavior and may be unaware of the need to change their approach. Patrick indicated no understanding of leadership as a group process, as something that can come from anyone in an organization. While he acknowledged the importance of helping younger members build task-oriented skills, he indicated no interest in developing members' leadership skills. He attributed organizational struggles to the failures of people in official positions to execute their responsibilities. "What kills a lot of leaders ... is just a lack of commitment and lack of caring .... By the end of the year, no one is following them, their organization is falling apart, it's treated as a joke." Patrick was not self-congratulatory. He saw leadership as a developmental process and recognized that he had not always been effective. "The more leadership responsibilities I take on, the less I understand how to do it right." Patrick had learned how to get things done by his own effort, but he had not learned how to lead through others.

## 7 | DISCUSSION

The preceding stories are representative of respondents' experiences along the continuum of LID. While ECT participation contributed to most respondents' LID (Research Questions 1 and 3), project complexity and team characteristics affected that development. Other influences on development (Research Question 2) included participation in other organizations, positional leadership experience outside ECT, enrollment in leadership courses and workshops, and preconceptions of leadership.

### 7.1 | RQ1: How does the ECT experience contribute to students' LID?

Phase 1 of this study (Wolfenbarger & Shehab, 2015) established that design competitions provide multiple avenues for learning and practicing a diverse set of leadership behaviors, both task-oriented and relational. The students' stories reported here indicate that ECT participation can have positive effects on LID as well, as expected from results of studies in other contexts (Ibarra et al., 2010). The ECT participants who had advanced through several stages learned that their task-oriented objectives were accomplished more effectively when they relied on influence and participative decision-making rather than direction from the top. They learned to work interdependently, relying on the skills of multiple people, because the projects were simply too large to be completed by a small group. Building relationships through work helped team members remain motivated and engaged. The challenging technical context promoted coaching behavior, and students who coached other team members developed a deep appreciation of the importance of coaching to team sustainability. The multiyear context of ECT helped participants develop a long view; those who remained with the team for several years experienced first-hand the need for the development of both technical and leadership skills throughout the organization.

The diverse activities available within ECT also helped move some students from a situational leadership view to an internalized leader identity. Some students focused primarily on one aspect of the project—design or manufacturing—and considered themselves leaders only in those contexts where they possessed expertise. But those who exercised a broad range of responsibilities such as project management, financial management, boundary-spanning, and coaching learned that they could be leaders in a variety of contexts.

The contribution of ECT participation to LID was neither uniform nor inevitable. The interview responses revealed important team-level differences, particularly with regard to claiming and granting, social structure, and project complexity. Within ECT itself, the claiming and granting processes (DeRue et al., 2009) central to LID were evident, although they were manifested in different ways for different students and on different teams. Within Team A, granting was based in part on leader-like behaviors. Recall, for example, that Connor was "already leading in the right direction" before being appointed captain, his first office on the team. This act of granting reinforced the leader identity that Connor already possessed and encouraged him to engage in claiming behaviors such as using his selection as captain "as leverage to change some of the team management style." Luke was recognized as a leader for his patience, positive

attitude, and coaching skills; being granted a leadership position accelerated his LID and allowed him, for the first time, to claim a leadership identity.

On Team B, granting of leadership positions was based primarily on team tenure and “experience,” a phenomenon noted by several of the respondents and regretted by a few. Seniors were generally the only students considered for the captaincy, even if others demonstrated the relevant leadership skills better. While the internal team environment was friendly and inclusive, decision-making and access to leadership positions were still largely hierarchical. Team members—including officers—tended to defer to the captain for major decisions and waited for the captain to act or delegate, even when the members knew what actions needed to be taken. This deference to the hierarchy may have affected some members’ willingness to claim a leadership identity. Tom, for example, had extensive knowledge of team processes but sometimes would not take the initiative if it meant “stepping on Danna’s toes.” Danna, in turn, complained that Tom would not act unless Danna gave specific direction. Danna had been granted the captaincy based on the tenure-based hierarchy, and yet she knew that she was not the best choice: “I kind of wish we had taken a chance on [a junior].” Occupying the chief executive role without the requisite practical knowledge had not encouraged Danna to claim a leadership identity; she still was hesitant “to be seen as a full-on leader.”

Claiming and granting may have also been related to project complexity. Members of both teams found their projects technically, managerially, and interpersonally challenging, and their responses indicated that ECT provided extensive opportunity to develop leadership skills. In this way, ECT gave members a diversity of ways to “try on leadership” (Komives et al., 2005, p. 605) and provided a variety of situations in which to exercise different leadership styles, manage conflict, and handle advanced leadership activities such as boundary-spanning (Wolfinbarger & Shehab, 2015). And yet, team-level differences may have played a role here as well. In Figure 1, Team B members are clustered on the left (Stages 3–4), while Team A members are clustered on the right (Stages 4–6). Years on a team and officer status seem comparatively less important to LID, while project complexity may have accelerated participants’ LID. Team A’s project was more technically complex than Team B’s project; in fact, the component assemblies of Team A’s product were more complex than the finished product of Team B. While both teams offered opportunities to develop leadership skills and a relational leadership identity, Team A provided more opportunities for individual members to interact with each other in an interdependent fashion. This complexity also meant that a given Team A member put more work into the project than a typical Team B member. The Team A members interviewed all reported working more hours than the members of Team B. Patrick complained that all the Team B officers were “busy” and involved in numerous other organizations, a claim supported by Tom and Danna’s reports of their own behavior. The finding that Team A members exhibited greater levels of advancement along the LID stages than Team B members supports Komives and colleagues’ assertion that immersion in one group, especially a group that provides multiple and diverse opportunities to exercise leadership skills, has a positive effect on LID.

## 7.2 | RQ2: What other factors influence ECT participants’ LID?

As I expected, other out-of-class activities, exposure to leadership concepts through the curriculum, occupying positional leadership roles, and precollegiate experiences all affected students’ understanding of leadership. But the effects on their LID were not always consistent. I was surprised to find, for example, that *positional leadership experience* did not predict a student’s LID stage. Some students with limited positional leadership experience (such as Luke) exhibited strong relational leadership identities, while some others who had held several leadership positions in various groups (such as Tom and Patrick) were not as far along the LID spectrum.

*The extent of a student’s participation in ECT* relative to other organizations contributed strongly to their LID. Komives et al. (2006) found that immersive experiences facilitated such development, and a similar pattern was evident in this study. Connor, Mark, and Luke had chosen ECT as their only collegiate co-curricular activity, and all three progressed two levels from their estimated LID stage at matriculation. Those who were heavily involved in more than one collegiate organization experienced less growth; none of these students (including but not limited to Patrick, Tom, and Danna) had progressed beyond Stage 4. Their experiences suggest that spreading oneself too thin can hinder LID.

In addition to activities outside the classroom, some participants *learned about leadership through the curriculum* and were able to connect concepts from these courses to their competition teams. In particular, one student cited a lecture as confirming practices already exercised within the team, supporting Komives et al.’s (2006) assertion that Stage 4 students are learning the leadership vocabulary to apply to their actions.

*Precollegiate organizational experiences* differed widely among the students interviewed. For students without significant precollegiate leadership experience—or even organizational involvement—the engineering team provided an opportunity to develop leadership capacity through a series of progressively larger assignments. Several interviewees had not seen themselves as leaders before joining ECT. One talked about being asked to mentor younger members. “I’ve never done that before [this year] .... It’s a lot harder than it looks.” Another told about recruiting two first-year students to help organize a large number of donated materials. “I managed those two guys and I was proud of myself because that was my first—It was weird because it’s not really in my demeanor to tell people what to do.” ECT gave these students the opportunity to assume leadership roles that they may not have pursued in environments that required self-selection as a leader.

For students with precollegiate leadership experience, ECT provided opportunities for leadership to expand to new contexts. Several described how the new context of an engineering team required new approaches, particularly greater attention to interpersonal skills, more collaboration, and an increased emphasis on technical knowledge.

The impact of *preconceptions of leadership* was most evident among students with negative views. Those who had developed a negative perception of leadership in high school still expressed this aversion; even the ones who had several years of ECT experience were reluctant to call themselves leaders and had identities no higher than the Key Transition. Those reporting neutral or positive prior views of leadership exhibited the full range of collegiate LID stages, from Stage 3 to Stage 6.

### 7.3 | RQ3: Does the ECT experience provide opportunities for LID that are different from those provided by other experiences?

The answer to this final research question has important implications for developing a theory of engineering leadership identity. Respondents described many ways in which ECT contributed to their LID, but most of these contributions were also cited in relation to other experiences at least once. The exception was technical competence. Within ECT, perceptions of technical competence were closely linked to leadership identity. This association of leadership with expertise is consistent with investigations of leadership in various creative and research endeavors (Elkins & Keller, 2003; Mumford et al., 2007), Formula One racing (Goodall & Pogrebná, 2015), research universities (Goodall, 2006, 2009), and hospitals (Goodall, 2011). Unlike the working engineers in the Rottmann et al.’s (2015) study, a conflict between technical competence and leadership identity was not evident; to the contrary, technical competence contributed strongly to both leader selection and the development of a leader self-concept.

Knowledge and technical skill were associated with leadership by every team member interviewed and formed a basis for both claiming and granting behavior. Here students were enacting a familiar phenomenon (Foor, Walden, Shehab, et al., 2013; Foor, Walden, Trytten, et al., 2013; Hogg et al., 2003): Their leadership identities were tied closely to their similarity to the group’s prototypical identity. As a Team A officer put it, “the people who get their stuff done ... in a timely manner and with good quality, ... they’re going to be the ones making the key decisions on the team.” A Team B officer observed that team members will follow a person’s lead only “if they think you know what you’re talking about ... and that’s different from the leadership experience I’ve had in the past.” A Team A member who called himself “an educator” situated his leader identity in his ability to teach others and “[get] manufacturing done.” A veteran Team A member said she had not learned how to lead “without using my knowledge base.” The opposite was also true: Tom—a Team B officer—believed that he was not a leader on the team in part because his knowledge of an important material was limited. And while technical expertise was not the only way a person could be identified as a leader within ECT, it clearly had the potential to function as both a barrier to and a path toward developing a mature leadership identity. This emphasis on technical competence as a characteristic of leaders provides support for the existence of a distinct engineering leadership identity.

## 8 | CONCLUSION

The ECT experience clearly enhanced the LID of most students interviewed. Participation promoted students’ understanding of leadership as a relational process as they moved from the “Leader Identified” stage to higher levels. The teams offered members the opportunity to exercise leadership in diverse ways, exposing them to new situations with challenging constraints and requiring a higher level of performance than they had experienced through other types of organizations. The lack of conflict between engineer identity and leadership identity suggests that participation in ECTs may help students bridge the gap between leadership as theory and leadership as an engineering practice.

Researchers have only recently begun exploring the leadership identity of engineers and engineering students, and this project is the first known to use the LID model in the context of ECTs. Consistent with other leader identity research, the findings show that students did not necessarily develop a relational leadership identity simply by participating in ECT. Those whose LID advanced had learned about relational leadership—from the curriculum, from peer exemplars, and from coaching by teammates and advisors—and they had reflectively applied these lessons to their work on the team. They had been given opportunities to practice leadership at increasing levels of responsibility, starting with teaching technical skills to new members or directing small project teams. And they learned to work interdependently by building a complex and technically challenging product.

Intentional coaching, learning, and framing of experience around the LID model provide great opportunity for LID within ECTs. Team advisors can promote this development in two different ways. First, advisors can use the LID model to identify a team member's probable stage and provide appropriate coaching interventions. Second, advisors can explicitly teach the model and its associated relational leadership behaviors, allowing students to become reflective practitioners and, as a result, advance their own LID. In turn, ECT members can use the model to foster a positive internal environment and to define roles and team processes that provide scaffolded opportunities to practice technical, teamwork, and leadership skills. Teams should adopt practices that promote organizational sustainability and full inclusion of members in decision-making. Experienced team members should model relational leadership, both in positional and nonpositional roles. And teams should encourage members who exhibit relational behaviors to accept official responsibilities.

Given the importance of technical competence to the claiming and granting process of leadership development within ECT, teams should provide opportunities for their new members to make meaningful contributions while learning technical skills. But the responsibility for practical training should not be left to the teams alone. Institutions can promote equity and access by ensuring that all students have the opportunity early in their education to develop the types of skills valued by ECTs. Learning to use modeling software, machine tools, and other technical equipment will benefit not just ECT participants but the engineering student body as a whole. Institutions should expand opportunities for students to participate in complex, extended, interdependent projects in noncompetitive settings as well, including service learning and undergraduate research. Finally, institutions should not relegate leadership development activities to the co-curricular domain (Knight & Novoselich, 2017). Teaching relational leadership skills within the formal engineering curriculum will improve students' performance in all team-based settings, from the lab to the shop to capstone courses, and will promote the conception of engineering as a leadership profession.

Although many questions about leadership development among engineering students remain unanswered, the LID model offers promise for designing formal engineering leadership development programs, assessing students' progress, and designing effective interventions. And while this research focused on students' individual experiences, future work will explore the connection between individual LID and the team-level development of leadership capacity. Engaging in focused, extended, and complex technical team experiences may be the key to developing an engineering leadership identity.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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