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Design Your Future: Embedding Leadership and Career Development Into a Cornerstone Design Course*

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Engineering leadership skills have been identified as a hallmark of the engineer of the future. In addition, employers seek to hire engineers with not only solid technical grounding but also strong non-technical skills. This study sought to understand which competencies of entry-level engineers were sought by recruiters during on-campus career fairs. Themes identified included participation in meaningful experiences, ability to connect these experiences to potential employment opportunities, and key behaviors such as strong communication, humble confidence, initiative, and collaborative problem solving. Beyond simply taking part in an experience, successful engineering leaders should be able to clearly articulate their contributions to these experiences and how they have solved problems (both technical and interpersonal) as well as align their combined competencies to the potential job. Cornerstone engineering design courses offer students the opportunity to develop many of these non-technical skills, such as teamwork and communication, through project-based learning in teams. Therefore, these courses are uniquely positioned to impact how a student reflects upon, and ultimately articulates, these experiences. In addition, since these courses often provide an introduction to engineering as a profession, the course is also able to help the student align their selected experiences to their career path. This paper suggests incorporating a three-part module based on career development theory into cornerstone design courses to better prepare students for their future engineering careers. In the first module, students develop self- and occupational-knowledge through interviews and discussions. The second module allows students to apply the engineering design process to a career problem by developing a career plan. Finally, the third module invites students to reflect on their experiences and plan and deliver an introductory speech, as would be expected at a career fair. By intervening early in their educational career, this type of module enables engineering students to meaningfully design their future.

Keywords: engineering design; engineering leadership; career development model; professional development; student-recruiter interactions

1. Introduction

According to the National Academy of Engineering (NAE), an engineer of the future must understand and apply leadership principles throughout their career [1]. Employers, seeking to hire the next generation of engineers, expect graduates to not only possess a solid grounding in technical knowledge and skills, but also to demonstrate non-technical skills in the form of leadership abilities. Industry calls for reform in engineering education reflect this expectation [2, 3]. Increasing course credits to accommodate important non-technical aspects of engineering poses challenges due to the already intense curriculum requirements in engineering education as well as the problem of attrition due to the workload [2, 4]. Engineering educators, then, are working to meet this requirement through leadership development programs. Numerous programs have been recognized for their innovative curricula and course projects that aim to build leadership in alignment with workforce needs [5–9]. Some of these programs are characterized as stand-alone programs, defined as a minor or co-curricular activity. Others are characterized as embedded initiatives, which "embed" leadership concepts into current engineering curricula.

Non-technical needs of future engineers center on various competencies related to the practice of engineering. Specifically, many studies highlight these non-technical competencies as communication, teamwork, problem solving, dealing with conflict, good interpersonal skills and an understanding of business [10–17]. Engineering leadership studies have emerged with similar themes related to competencies associated with the practice of engineering, specifically communication skills, teamwork, big picture thinking, and interpersonal skills [18–20]. These studies support the emergence of leadership development programs in engineering curricula to address the non-technical competencies needed for successful engineers.

Industry-identified leadership competencies are harder and costlier to develop and therefore are key drivers in the selection process for recruiters [21]. During the hiring process, industry recruiters rate non-technical competencies over technical competencies when identifying top talent [22]. This does not mean that technical abilities are not important. Rather, it indicates that the technical competencies

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(knowledge and skill) are easier to identify while many of the non-technical leadership competencies (communication, teaming, interpersonal skills, etc.) serve as differentiators in student-recruiter interactions. These non-technical attributes are key to the initial hiring of engineers and contribute to promotion and career success [16, 17, 23]. Sageev & Romanowski portray this importance in their research through the following quote: "Technical abilities are a given, communication and leadership differentiate" [16, p.601].

With leadership competencies (e.g., communication, teamwork, and interpersonal skill) topping the list of important characteristics of top hires, it is important to gain a better understanding of which behaviors alert employers of leadership competencies in engineering undergraduates. The studies identified in this review focus on employer perceptions of engineering graduates' behaviors once they have entered the workplace. There is a gap in the literature regarding recruiter perspectives on behaviors associated with engineering leadership competencies identified during on-campus recruiting activities for internships, co-ops, or full-time jobs. The student-recruiter interactions are the first opportunity for a professional, outside the university, to observe and judge the technical and non-technical competencies of engineering students based on the job opportunities available. To address the competency gap of recent engineering graduates, Nair, Patil, and Mertova suggest academic institutions include a focus on: (a) having a better understanding of the competency requirements for engineering graduates; (b) ensuring universities are working with industry more closely for competency needs; (c) aligning competencies identified by industry in the engineering programs and curricula [11]. Developing a better understanding of which behaviors industry expects in non-technical competencies requires interaction with industry, specifically recruiters. After a better understanding of the recruiters' perspective, aligning the competencies within engineering programs and curricula requires embedding the concepts with effective learning strategies into courses.

Cornerstone design courses are positioned to address the non-technical competencies identified by industry. Cornerstone design courses were originally developed to provide an opportunity for first-year engineering students who may otherwise not be exposed to any engineering faculty until the third or fourth year. These courses also expose students to engineering projects and experiences in an effort to impact attrition [24]. Established design competencies for cornerstone design students include: teamwork, information gathering, problem definition, idea generation, evaluation and decision-making, implementation, and communication [25]. NSF initiatives funding cornerstone design courses have focused learning objectives on providing better career preparation for engineers [26], and indeed, a review of literature supports the notion that design education prepares students for the practice of engineering [27]. Cornerstone courses in engineering design provide an opportunity for team-based projects where students can apply engineering design concepts as well as develop and practice non-technical competencies related to the practice of engineering, such as communication, teaming, and interpersonal skills [28, 29].

Cornerstone design courses provide a potential solution to embed leadership competencies within an engineering course; however, they would require different learning tools, techniques, and theory. Additionally, current methods of teaching in the cornerstone classes may not effectively use career development theories and interventions to impact student interest in engineering as a career path in an effort to impact attrition. The career development field focuses on psychological, behavioral, and contextual factors that influence a person's career over a life-time and include interventions such as developing self-awareness, occupational-awareness, decision-making skills and job-search skills [30]. Career development theory construction dates back to the early 1900s with Parson's work, which focused on developing self-understanding and occupational-knowledge to make a career choice [31]. Other traditional career development theories include differing perspectives on adult career decision-making; however, each includes core underlying themes associated with self-understanding, occupational-knowledge, development of necessary skills, and influences on career decision-making [31–33]. More recent theories on career development and decision-making focus on more cognitive approaches to career theory and practice. An example includes the cognitive information processing (CIP) approach. The CIP approach incorporates cognitive information processing with the Parsonian approach of self-understanding and occupational-knowledge in career decision-making [30]. Essentially, this approach explains how the three areas of cognition-knowledge domain, decision-making skills domain, and executive processing domain influence the career decision-making process [34]. Career development theory and interventions can provide a framework for a cornerstone design module that incorporates effective learning strategies to impact self- and occupational-knowledge related to engineering leadership competencies and career decision-making.

The purpose of this research is to describe an embedded module for cornerstone engineering

design courses, informed by industry recruiters and career development theory. The module will enable students to develop (1) an understanding of the importance of leadership competencies within an engineering context and (2) skills in demonstrating leadership behaviors during the on-campus recruiting process. Through a qualitative approach, the study will first explore recruiter-identified behaviors associated with leadership during the on-campus recruiting process. Utilizing the information gathered from recruiters, the authors propose a module for cornerstone engineering design courses to address the leadership competency needs in an effort to impact student career development and attrition within the engineering profession.

2. Presentation

2.1 Methods

Non-technical competencies related to leadership within the engineering context are difficult to assess and develop. Recruiters, seeking to hire entry-level graduates, consistently rate leadership competencies such as teaming, communication, project management, problem solving, and interpersonal characteristics as key differentiators for potential new engineering hires [19, 22]. During the on-campus recruiting process, student-recruiter interactions take place in settings such as busy career fairs or one-on-one interview situations. Ninety-six percent of employers seeking entry-level talent do so through on-campus recruiting activities [35]. Therefore, an engineering student first describes their personal competencies in a career fair setting, and the potential of the student is judged through the initial student-recruiter interactions. Exploring the experiences of recruiters, who seek to identify leadership competencies in the on-campus setting, can help to inform undergraduate curricula as to the specific behavioral outcomes related to leadership competencies important for entry-level engineers.

The exploratory nature of this study lends itself to a qualitative approach. The study focused on exploring how a recruiter perceives engineering leadership competencies during busy career fairs and how the behaviors associated with engineering leadership are best demonstrated through student-recruiter interactions [36]. A qualitative approach is best used when the researcher situates themselves in the context by which the problem resides and explores the lived experiences of individuals associated with the problem [37, 38]. In this study, a basic qualitative approach using open-ended survey questions provided the exploratory analysis of student-recruiter interactions during the busy career fair setting. Recruiters were selected who participated in a large engineering career fair at a large northeastern university. Recruiters were solicited to complete five open-ended survey questions, which are included in Table 1. Eighty-five recruiters from small, medium, and large companies that hired across multiple disciplines participated in the study. Participant descriptions are outlined in Table 2. This qualitative approach allowed the researchers to explore the concept of leadership from the perspective of an engineering recruiter, typically the first off-campus ''judge'' of the next generation of engineers.

Three independent coders analyzed the data using open and axial coding strategies associated with grounded theory studies. An initial pilot study was conducted analyzing a portion of the data, which was organized into open codes and reviewed by the three independent coders prior to analyzing

Table 1. Description of the five open-ended survey questions supplied to the participants

1. Describe what it is like to try to identify potential engineering leaders at the career fair? (Please describe in as much detail as possible)
2. What leadership behaviors are important for engineering students to communicate during the on-campus recruiting process?
3. Recall and briefly summarize one example of a student's 30-second pitch at the career fair or answer to an interview question, which demonstrated important engineering leadership behaviors. Please describe one answer where a student failed to demonstrate important engineering leadership behaviors.
4. Describe strategies you use to elicit an understanding of important engineering leadership behaviors during the recruiting process.
5. What experiences or programs pique your interest in working to identify potential engineering leaders during the recruiting process? How should these experiences or programs be described through the recruiting process?

Table 2. Descriptions of study participants

Company Type	Count	Company Size	Count
Private	34	Large	41
Public	43	Medium	25
Blank	7	Small	10
		Blank	8
Total	**84**	**Total**	**84**

the full data set. The open-coding process breaks apart data into concepts. Coders utilizing this strategy then question the data to determine why it may be interesting for the particular phenomenon in question [39]. Additionally, the pilot study open codes were organized into major themes and discussed with a focus group of six recruiters. This process provides credibility to the study through the involvement of the participants whose reality is being studied [40]. Axial coding puts the data back together in related concepts [41]. This process required the three independent coders to meet again after the full-data set was coded to discuss themes and discrepancies. This process resulted in rich discussion as to the important themes emerging from the data related to the purpose of the study.

2.2 Results

The overall themes emerging from the data fit into three categories: experiences employers are interested in hearing about, how employers gauge leadership, and employer-identified leadership attributes. These three categories include themes related to the purpose of the study and help to inform curriculum design for the cornerstone design course. Table 3 summarizes recruiters' perspectives on identifying leadership potential during student-recruiter interactions during the on-campus recruiting process. Details on each of these perspectives are included in the sections below.

2.2.1 Experiences

The first category describes the academic or extracurricular experiences that pique recruiters' interest. Experiences reported for this study were found most frequently in the open-coding process. Recruiters were interested in more than just a good GPA and wanted to see that students were active in extracurricular activities such as engineering projects, research, and student organizations, as well as internships, co-ops, and generic work experiences. Being active in these experiences emerged in this category as recruiters related engineering leadership potential with positional leadership and active involvement in an activity.

> "Any experience is good as long as they can show they are an active participant in one (or more) organizations. If they are only passive members, then I am less interested."

> "Identifying potential leaders can not be done based on a list of classes (or minors). You look for examples of actually leading—active involvement in groups or organizations, leading a group project to completion, or working where there is the ability to make decisions (versus only following a script or being told what to do)."

2.2.2 Gauging leadership

The second category describes how employers wanted to hear about the experiences the student participates in. This category includes how engineering students should describe their experiences during the student-recruiter exchange and includes specific behaviors and strategies associated with demonstrating engineering leadership. First, students who spoke about specific contributions within their experiences and appropriately described those experiences demonstrated engineering leadership potential.

> "Those who see above average as normal tend to join organizations they care about, not just societies for the bottom block of a resume. They see value in doing the work and building relationships and tend to talk about experiences as important parts of their learning; they also recognize which experiences are foundational and which are disposable."

Secondly, student-recruiter interactions where students demonstrated preparedness for the conversation were seen as having engineering leadership potential. In other words, these students were effectively prepared, researched the company, and could communicate their interests in company opportunities.

> "Any well communicated examples are great. It's really a dialogue. We also want them to know something about the company. Two things that stand out that kills their chances are: when they come to the table and say—what is "XXX" and "I'm just looking for any-

Table 3. Leadership behaviors identified by recruiters during student-recruiter interactions

Experiences: *What recruiters want to hear about*	• Active Involvement • Student Organizations • Engineering Projects & Research • Internships/Co-ops • Work Experiences
Gauging Leadership: *How recruiters want to hear about experiences*	• Describe specific experiences & contributions • Connect experiences to company opportunities & interest • Deliver information in a confident and passionate manner
Leadership Competencies: *Which leadership competencies should be described*	• Communication • Humble Confidence • Collaborative Problem-Solvers – Technical & Interpersonal • Self-Starter

thing to get my foot in the door". They need to have done their research. Their 30 second speech needs to highlight the key skills that would translate to the industry they are speaking to."

Next, students who could connect their experiences to the company also demonstrate leadership. Connecting experiences centered on students relating their specific experiences and contributions back to the employer opportunities, which required that students had previously researched the company. Additionally, researching the company and identifying interests demonstrated that the students not only had career goals but also connected them to company opportunities.

"One young lady approached me having done her homework on what our company does, where it is located, and a clearly articulated (with enthusiasm) goal to do software testing. Essentially, she was prepared, which made her stand out among other candidates. Preparation, ambition, clear communication—are all important qualities of a good leader. It is far too common for students to approach me asking me what the company does and not able to clearly communicate their interests and experiences that make them candidates I want to pursue."

Further, student-recruiter exchanges demonstrating leadership included portraying confidence in delivering the information related to experiences as well as a passion for the company based on the research conducted.

"For career fair—students who approach us with a clear objective in mind, are familiar with our company, talks about their most recent job experience and asks a lot of questions—you will be an "A" candidate. Those who are looking for "whatever I can get", don't know who we are, can't speak confidently about a work experience will get passed on immediately."

"I want the students to show full confidence to look me in the eye and tell me where their interests are, definitive answers are always best."

2.2.3 Leadership competencies

Recruiter responses further illuminated concepts related to which leadership behaviors engineers should highlight through their experiences. These competencies reflect what employers are looking for in engineering leaders.

2.2.3.1 Communication

The first competency centered on a student's ability to communicate the story of their experiences, focusing on what is important and succinctly providing appropriate details of the experience related to the job opportunity.

"The students need to be able to describe (both written and verbally) what they have done and led. They need to be able to describe how they were proactively solving issues, taking charge of a situation, and/or leading by example. Most people write their resume to say what they did. They need to be able to communicate what they can do and provide examples to prove it."

"I expect the candidate to respond to questions without getting stuck in the details. Specifically, if discussing how they resolved a technical problem, I look for the candidate to respond with an easy to understand explanation, rather than every little detail of how the resolution was found. Good leaders are excellent communicators."

2.2.3.2 Humble confidence

Recruiters also sought students who demonstrated confidence, but also humbleness. Humble confidence included students who could speak about their experiences without being cocky. This theme also focused on the importance of continuous learning. Humble confidence demonstrated that an engineer was confident in their current abilities but recognized the need to learn.

"I look for a strong, confident, and humble person. I look for an engineer who understands that they are entering the field and can still grow and is eager to continue to learns."

"Someone with balanced confidence is nice—confident that they can help out and learn but with an understanding that they have ALOT to learn."

2.2.3.3 Collaboration

It is no surprise that collaboration was a theme emerging from this study due to the identification of this need by industry and its incorporation into accreditation standards. Collaboration was discussed within the context of problem solving and interpersonal dynamics. Engineers as problem-solvers is a common descriptor of the profession and recruiters spoke about the importance of technical problem solving within a team. Leaders would demonstrate the importance of collaborating when solving problems.

"Company A expects its new candidates to lead through positive collaboration in team environments. We like it when students describe team problem solving techniques and practices which result in a more comprehensive solution to issues. We also appreciate it when students offer those examples of collaboration and teaming without prompting."

Additionally, recognizing the importance of teams, potential leaders could also describe problem solving from the interpersonal perspective. Recruiters focused on how working in teams also included solving difficult people problems and that leaders worked to solve not only the technical problems but also the interpersonal conflicts typical in teaming environments.

"Describe the role they have played working as part of a team. A lot of students describe teams they have participated on. They need to be more specific what was

> THEIR SPECIFIC role and/or contribution that enabled the team. If there was conflict don't describe generically how it was resolved but what they specifically did to resolve it.''

2.2.3.4 Self-starter

Self-starter describes a category of terms used by recruiters describing leadership behaviors such as taking initiative, tenacity, ambition, curiosity and drive. Engineers who were seen as self-starters described activities where they demonstrated a drive to accomplish results or to initiate something new.

> ''Drive Results—Set clear performance standards; overcome obstacles; hold themselves and others accountable for achieving results.''

> ''Being a motivated self-starter: I look for people who have demonstrated initiative to take on challenges. Those who act without being prompted and/or people who actively ask how they can contribute often make good leaders.''

3. Discussion

As discussed previously, Nair, Patil, and Mertova recommend that academic institutions focus on having a better understanding of competency needs by working more closely with industry and aligning the identified competencies with engineering curricula to address the competency gap between recent engineering graduates and industry needs [11]. This study identifies specific competencies that recruiters are looking for during on-campus recruitment activities that help them identify potential for leadership within their organizations. Key findings from this study suggest that the way in which students talk about their experiences and the competencies specifically described through those experiences help to illuminate competencies related to engineering leadership. One particular quote summarizes these findings:

> ''Recruiters want to see candidates who can articulate recent examples of leadership that go below the surface level, showing a time when they identified and addressed a personality conflict within the team, turned a struggling team around, addressed a performance issue of one of their teammates, took an organization to a new level, or recovered from a leadership mistake that resulted in them growing as a leader and their team WINNING . . . If done right, however, it shows humility, maturity, self-awareness and willingness to grow . . . all traits that companies hope to recruit into their leadership development programs.''

Leadership competencies identified in this study included communication, humble confidence, technical and interpersonal problem solving, particularly as they relate to collaborative efforts, and attributes that portray a self-starter. The study further explored the types of student experiences that help recruiters in identifying these needed competencies as well as how they are best articulated during the recruitment process. Recruiters indicated that the types of experiences that were most beneficial for evaluating leadership potential included participation in student organizations, engineering projects and research, internships and co-ops, and general work experience. What was most evident is that recruiters were more interested in hearing about those experiences that showcased active involvement on the part of the student. Recruiters also provided valuable insights into how students can best describe these experiences. They wanted to hear about specific experiences and contributions that provided a better understanding of what the student's capabilities are and how they relate to the company's interests and needs. Students need to articulate their interest in the company and be able to articulate what they learned from these experiences and how the experiences help to prepare them for the particular job that they are seeking. Recruiters are looking for students that are able to deliver information in a confident and passionate manner. These leadership competencies are difficult to articulate, and engineering programs can help to facilitate this ability in engineering graduates through existing courses.

Based on this study's findings, students need to participate in meaningful experiences that will provide opportunities to effectively deliver stories related to building competencies such as communication, teamwork, initiative, and continuous learning that align with career goals and interests. This conclusion assumes that students know that these are the important competencies to develop and have a clear understanding of their career goals and interests. The findings from this study may suggest that while students have the ability to develop these competencies, they lack the ability to effectively articulate the specific behaviors related to these competencies. In addition, ensuring that students are making meaningful choices in the types of projects and extracurricular activities that are best suited for their career goals can also be a focus within the design class.

As discussed previously, cornerstone engineering design courses often provide an engineering specific experience through which students learn and practice effective communication and work in teams to accomplish project-based learning objectives [24]. Cornerstone design courses also often focus on educating students on engineering as a profession. These attributes of a cornerstone design course provide an excellent opportunity for students to engage in meaningful experiences and build knowledge of career options. A reflection on project-based learning experiences and career knowledge enables

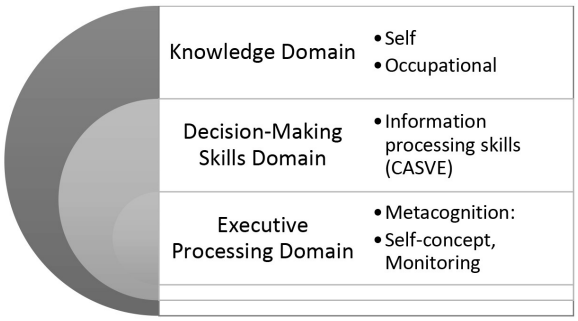

Fig. 1. Cognitive information processing domains. Adapted from Peterson et al., 2002 [34].

students to identify competencies related to the engineering profession. Through the lens of career development theory, cornerstone design courses can incorporate an additional component to impact the successful articulation of project-based learning experiences related to needed engineering competencies. Additionally, career development theory provides structure by which students can build upon self- and occupational-knowledge to develop a career plan within the engineering profession.

The cognitive information process (CIP) model of career development is a theoretical approach that incorporates both career theory and cognitive psychology and positions career decisions as problems which need to be solved [34]. Career decision problems are solved through the cognitive functions, which process both experiences and emotions in order to determine a solution. The model suggests that career choices are determined through three cognitive domains—knowledge, decision-making, and executive processing—that align with self-understanding, occupational-knowledge and career decision-making of foundational career theory [34]. Fig. 1 outlines the cognitive domains associated with the CIP model.

Self-knowledge is cognitively developed through the interpretations and reconstructions of events [34]. Occupational knowledge is developed through cognitive construction of new knowledge units combined with existing knowledge [34]. The knowledge domains (self- and occupational) inform the decision-making domain and include information processing skills, which form a cycle for decision-making. Peterson et al. describe the cycle as the CASVE decision-making process (Fig. 2): communication, analysis, synthesis, valuing, and execution [34]. The final cognitive function utilized in the CIP model is the executive processing domain, which includes metacognitions such as self-talk, self-awareness, and monitoring. These executive process functions are impacted by positive or negative self-talk on the career decision-making process; self-

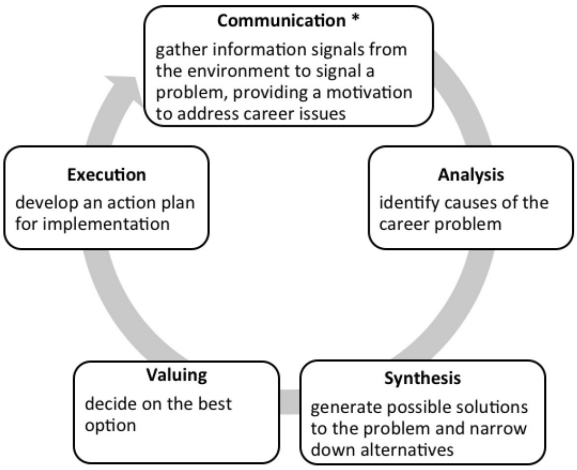

Fig. 2. Visual of the CASVE decision-making process. * User should return to the communication phase to evaluate successful decision-making that impacts identified career problem. Adapted from Peterson et al., 2002 [34].

awareness includes the ability to recognize performance in a task or the need for additional self- or occupational-knowledge; and monitoring functions keep an individual focused on the phase of the problem solving process and determines when to move to the next step [34].

3.1 The CIP model and recruiter perspectives

The CIP model provides a theoretical background to address key aspects of recruiter-identified behaviors associated with demonstrating engineering leadership during career fairs. First, the self- and occupational-knowledge domains provide an opportunity for students to reflect on career interests and their awareness of specific career or occupational knowledge. The knowledge cognition domain leads a student to become aware of gaps in career goals or awareness of occupational options. This relates to recruiters' comments regarding students knowing what they are interested in, knowing what the company does, and how the company fits within their interests. Additionally, the knowledge area may also highlight gaps in competencies needed for a particular occupation. The awareness of gaps then transitions to the decision-making cognitive domain which positions the students to make decisions to address the gaps identified in the knowledge domain. The execution phase of the CASVE model results in the development of a plan to address gaps of competencies related to leadership, occupational knowledge, and ability to effectively communicate competencies. Once the career problem is addressed in the CASVE model, the executive processing center monitors achievement of the plan and confidence in career decisions and task performance related to

Table 4. Comparison between the CASVE model and a generic engineering design process

CASVE Model		Generic Engineering Design Process	
Communication:	Identify the gap/problem	**Identify:**	Identify the problem
Analysis:	Identify reasons for the problem	**Define:**	Research the problem
Synthesis:	Generate alternatives	**Ideate:**	Generate many possible solutions
Valuing:	Decide on the best option	**Select:**	Select and prototype promising solution(s)
Execution:	Develop action plan	**Test:**	Test and refine prototype(s)

self- and occupational needs impacting student-recruiter interactions.

3.2 Incorporating the CIP model into a cornerstone design course

The CIP model provides a theoretical background for designing modules for a cornerstone design course to address recruiters' perspectives in determining leadership competencies during on-campus recruiting interactions. The authors suggest incorporating three modules into a cornerstone design course informed by the CIP model to impact students' abilities to effectively articulate leadership competencies relevant to the practice of engineering.

3.2.1 Module 1

Focused on self- and occupational-knowledge, Module 1 is delivered at the beginning of the semester and incorporates activities centered on exploring personal interests, traits, and strengths as well as the professional and competency needs of the engineering profession. The three learning goals of this module related to the perceptions of recruiters include:

1. Develop self-knowledge of career interests.
2. Explore the profession of engineering and engineering specific disciplines.
3. Recognize the importance of both technical and non-technical competencies in the engineering profession.

Activities that could be incorporated into this module could include lectures, assignments, and interactive discussion. Examples include:

- In-class exploration of engineering as a profession as well as majors offered at the institution.
- Student-led interviews of faculty or upperclassmen on different majors, followed by in-class reporting of their findings.
- Out-of-class meeting with a career counselor that focuses on self-discovery of interests and traits.
- Discussion of the importance of both technical and non-technical competencies and opportunities to develop communication and teamwork within the cornerstone design course. Such activities may include analyzing case studies, reviewing job descriptions for entry-, mid-, and upper-level engineering career paths, or assigning current articles or journals related to the practice of engineering.

3.2.2 Module 2

Module 2 moves from the knowledge domain to the information-processing domain by applying the self- and occupational-knowledge from Module 1 to the CASVE career problem solving process. Students begin designing their future career by applying the design process to address problems related to career development. By mapping the CASVE model to the engineering design process (Table 4; a generic engineering design process is shown which incorporates steps typically found in design processes), students can develop a better understanding of the design process through personal application towards designing their future.

The major deliverable for Module 2 requires students to produce a career plan using the design process as a framework to reflect on the application of self- and occupational-knowledge towards solving a career problem. The learning objectives for this module include:

1. Define the design process and its relation to problem solving and engineering solutions.
2. Relate the design process to personal problem solving and decision-making related to careers in engineering.
3. Recognize career-related problems (informed by Module 1) and apply the design process to develop a career plan.

After being introduced to the design process, students should be provided an assignment with instructions to relate the design process to development of a career plan to address problems emerging from the self- and occupational-knowledge developed in Module 1. An example of this assignment is outlined in Fig. 3.

The career plan should include a lengthy document with specific measurable goals and outcomes for students to work towards. Evaluation of the career plan should be encouraged at the end of the semester and adjustments made based on learning experiences both in and out of the cornerstone design course. Questions students should consider

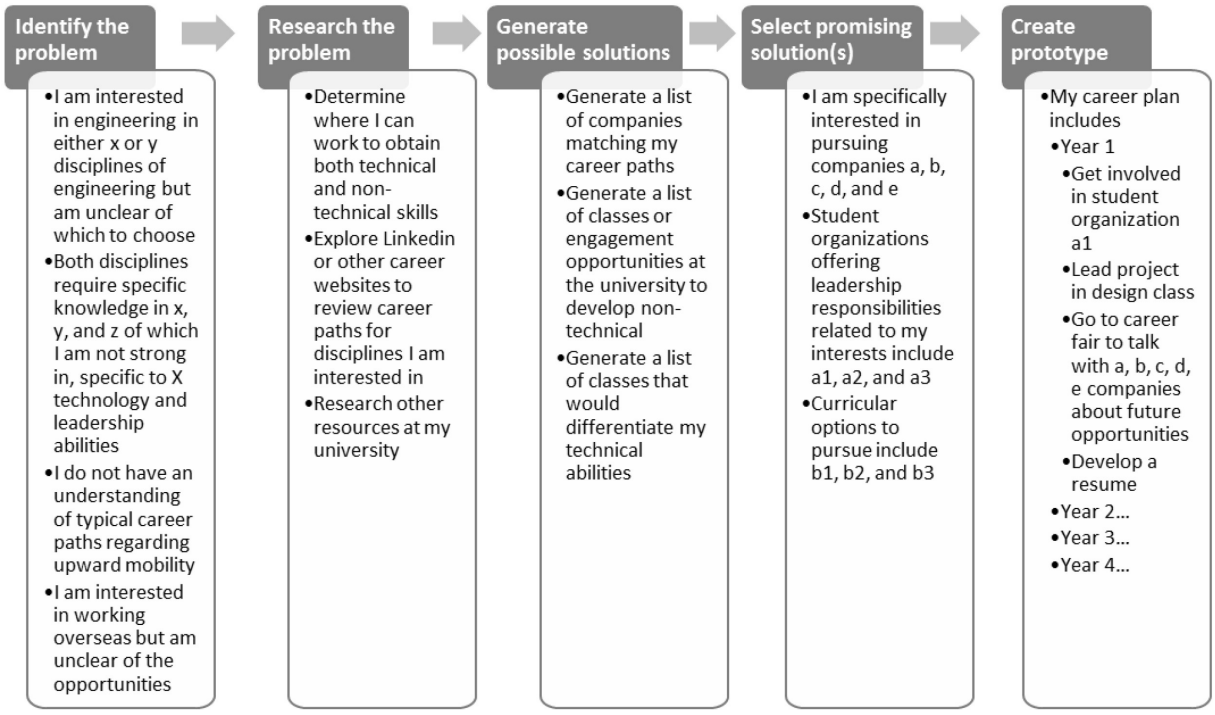

Fig. 3. Example assignment for Module 2 that enables a student to apply the engineering design process towards their career goals.

related to recruiters' perspectives that should be addressed through this assignment include:

- What experiences (student organizations, internships/co-ops, engineering projects or research) should I plan to participate in to meet my career goals?
- Which companies am I interested in and why?
- What about my experiences will assist in developing the competencies needed for the career I am interested in?

By answering these questions through the design your future process, students will be able to make informed decisions regarding involvement in meaningful experiences related to their career path interests. This assignment also helps students to begin to develop an ability to articulate why they are interested in a company, aligning with effective student-recruiter interactions from this study.

3.2.3 Module 3

Cornerstone design courses centered on project-based learning in teams are ideal for implementation of Module 3. Module 3, offered at the end of the semester, requires that a student reflect on their experiences in the cornerstone course as well as any outside-of-class activities implemented based on their career plan developed in Module 2. Through this module, students will reflect on the competencies learned through their experiences during the semester and begin crafting and practicing conversations for effective student-recruiter exchanges. The deliverable for this module includes the delivery of an introductory speech for a company of interest. The learning objectives associated with this module include:

1. Identify the key attributes of an effective introductory speech.
2. Apply reflections of experiences and self- and occupational-knowledge to introductory speech creation.
3. Practice delivering introductory speeches.

Activities associated with this module should incorporate knowledge development of effective introductory speeches for student-recruiter exchanges and be informed by research based on recruiter feedback and perceptions. The findings from this study and Handley, Lang, and Erdman are helpful in educating students on the important attributes of delivering an introductory speech for student-recruiter exchanges [36]. This module aligns with the current findings in that introductory speeches require students to have participated in some kind of meaningful experience in which the student reflects and describes specific behaviors of relevant competencies for the company of interest. Additionally, by delivering an introductory speech, students have an opportunity to utilize executive processing, the final cognitive domain in the CIP model. Self-awareness resulting in the need for more practice or more knowledge is a possible outcome of

the development and practice of the introductory speech and requires monitoring functions to return to the decision-making process to address any additional problems arising from the experience. During this module, instructors should create encouraging learning environments for optimal outcomes. Ideally, students are addressing recruiters' needs for confident delivery of experiences and competencies related to the practice of engineering.

Activities incorporated into this module could include lectures, activities, or industry-related involvement. Examples include:

- Instructor-led lecture on effective introductory speeches with time for student development and peer review.
- Formal presentation of introductory speeches in a classroom setting.
- Mock Career Fair with employer participation [42].
- Coordination with career services staff to provide feedback for student performance.
- Written student reflection on their performance in delivering the introductory speech based on the criteria learned through the lecture and discussion of strengths and areas for improvement.

4. Study limitations

This study utilized a qualitative design to generate themes related to the demonstration of engineering leadership potential during a career fair. Data were collected from recruiters during an on-campus career fair based on observed student behaviors. The criteria for participant selection for this study required that recruiters represented entry-level engineering positions. A limitation of this study is that the researchers do not have a complete profile of the participant recruiters. It would be informative to have a better understanding of the recruiter's role in the company (i.e., whether they are an engineer, a hiring manager or human resource staff) and their level of understanding of the internal needs of the company as well as the positions that are being filled. The use of hand written or emailed qualitative questionnaires as the data collection method limited our ability to conduct additional probing that is possible through in-person interviews. In-person interviews would have allowed for further clarification when the participant's response does not completely address the question or indicates a misunderstanding of the question. The ability to generate themes and descriptors within various contexts highlights the value of qualitative research; however, it may limit the generalizability of the data as the study was limited to one institution [43]. Another limitation of this study relates to quantifying the size of participating companies. Participants were asked to indicate the size of their company as small, medium or large. As this rating is highly subjective, it would have been more informative to have participants quantify the company size. Giving equal weight to small and large companies may have also masked other important relationships. It is possible that recruiters from small companies have a different understanding of the requirements of the position and company compared to larger companies and may influence their evaluation of student behaviors. Without additional information related to recruiter knowledge and company size, it is difficult to tease out these types of relationships. A major limitation of this paper is that the described modules are a work in progress and further insights will be gained once the modules have been implemented in practice. The authors believe, based on career development theory, that the modules will positively impact attrition rates within the engineering profession; however, until long-term studies are conducted this assertion remains untested. This study has intentionally focused on incorporating the recruiter's perspective (as a surrogate for the employer). The authors plan to seek input from students during initial module deployment to refine the modules and further adapt them to the needs of the student. Following this initial refinement, the authors plan to conduct long term follow up of student retention within the engineering profession as well as student evaluation of the impact of early exposure to career planning on career trajectories and success in the engineering profession.

5. Conclusions

Based on findings from this study, the authors suggest that cornerstone design courses are ideally situated within the temporal space of the student's early educational career to help facilitate a better understanding of the engineering profession as well as the student's career goals and help the student to develop their ability to articulate these competencies while formulating a career plan. To effectively implement this in the classroom requires the incorporation of career development theory. The CIP model for career development introduced in this paper connects career problem solving to the design process, and provides three modules, which address the concerns identified in student-recruiter interactions. In the first module, students develop self- and occupational-knowledge through interviews and discussions. The second module allows students to apply the engineering design process to a career problem by developing a career plan. Finally, the third module invites students to reflect on their

experiences and plan and deliver an introductory speech. By intervening early in their educational career, this type of module enables engineering students to meaningfully design their future.

The challenge of introducing leadership competencies into already packed engineering curricula has resulted in both stand alone and embedded courses focused on key industry-identified non-technical competencies. The challenge is further increased in that these leadership competencies are not easily developed and require different learning strategies. The use of career development theory suggested in this paper reflects the need for inter-disciplinary learning strategies, which may be foreign to many engineering instructors. However, aligning career theory to already established norms in cornerstone design courses creates an embedded structure with minimal disruption to curricula. The current study further recommends that after the completion of these modules, engineering educators should encourage students to revisit, review, and revise their career plan and continue to reflect on activities, which build key non-technical competencies important for engineers.

Future opportunities include developing modules to address engineering students' abilities to effectively demonstrate leadership competencies during the interview process. Behavioral-based interviewing focuses on looking at past behaviors to predict future success in identified job tasks. The knowledge and reflective practices in this study provide a foundation to increase effectiveness in articulating leadership competencies during interview interactions. Mock interviewing is a widely practiced career development intervention and can be incorporated into junior and senior engineering activities or embedded modules [44, 45]. In addition, the engineering leadership competencies emerging from this study contribute to the body of knowledge aimed at defining leadership within the engineering context. The recruiter-identified leadership competencies can be used to inform larger studies seeking to develop competency models centered on identifying engineering leadership behaviors.

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