# Research Methods for the Capstone to Work (C2W) Project

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**Study Overview**
The Capstone To Work (C2W) project used a longitudinal multi-case design (Yin, 2014) that combined intensive quantitative and qualitative survey data over participants' first twelve weeks of work with interviews at regular intervals throughout their first year of work. Participants were drawn from capstone programs at four different institutions.

**Participants**
Participants for this study were recruited from capstone design courses at four geographically diverse institutions within the U.S. Three of the capstone courses were in mechanical engineering programs and one was in an engineering science program. Mechanical engineering was selected as the primary discipline for the following reasons:

1. It is the largest discipline nationally in terms of undergraduate degrees (Roy, 2018; Yoder, 2015, 2017).
2. It represents an archetypal engineering design domain with a strong industry focus.
3. Its graduates enter a diverse array of workplaces across multiple industry sectors.

The engineering science program provides a comparative case designed to explore the potential for differences by discipline.

*Capstone Course Pedagogical Approach*
Central to all four sites, and a core source of literal replication across the programs, is a strong emphasis on workplace orientation in the capstone course. All four sites maintain a similar philosophy regarding the essential features for a capstone design experience: a professional workplace environment, applied design projects, teamwork, a combination of formal and informal written and oral documentation, multifaceted advising (sponsor and faculty), student responsibility and autonomy, and an emphasis on professional practice. The course coordinators intentionally model workplace practices and actively coach students on critical workplace skills and attitudes. Moreover, the primary learning objectives for all four sites are similar (Appendix A: Capstone Design Learning Objectives from Four Sites). The capstone experiences at these four sites also match current trends in capstone design education (Howe et al., 2017), especially in 2-semester (or longer) course duration, projects sourced primarily from industry/government and faculty, multiple distinct projects in a given class, and course deliverables that include reports, presentations, design reviews, and product demonstrations.

*Capstone Course Logistics*
All sites include at least a full-year of senior design; one has a 4-semester sequence that begins in students' junior year. All include industry-sponsored projects, though most include faculty-sponsored and competition projects as well. Finally, all use a course coordinator coupled with individual faculty and/or industry mentors assigned to each team. Team sizes range, but the average across institutions is 4-7 students per team.

In addition to the comparative case provided by the engineering science program, the sites differ in program size, ranging from a small program graduating 35-45 students annually to larger programs with over 400 graduates per year.

Table 1 summarizes the key course features for each site. Participants were recruited from two separate graduating years (referred to as Cohort 1 and Cohort 2) to mitigate cohort effects.

Table 1: Capstone Course Logistics at Participating Research Sites

| **Capstone Course Features** | **Site A** | **Site B** | **Site C** | **Site D** |
|---|---|---|---|---|
| **Course Duration** | 2 semesters | 4 semesters | 2 semesters | 2 semesters |
| **Discipline** | Mechanical Engineering | Mechanical Engineering | Engineering Science | Mechanical Engineering |
| **Advising Structure** | Course instructor oversees; faculty advisors mentor teams (instructor also advises some teams), client-based teams have industry liaisons | Course instructor oversees; faculty advisors mentor teams, client-based teams have industry liaisons | Course instructor oversees and advises all teams, client-based teams have industry liaisons | Course instructor oversees; faculty advisors mentor teams, client-based teams have industry liaisons |
| **Major Assignments** | Reports (3)<br>Presentations (4)<br>Poster (1)<br>Design Reviews (4)<br>Product Demo (1)<br>Expo (1) | Reports (6)<br>Presentations (4)<br>Poster (2)<br>Design Reviews (2)<br>Expo (2) | Reports (3)<br>Presentations (3)<br>Poster (1)<br>Design Reviews (3) | Reports (5-8)<br>Negotiated Reports (3)<br>Presentations (6-9)<br>Negotiated Presentations (3)<br>Poster (1)<br>Design Reviews (4)<br>Expo (1) |
| **Previous Design Experiences** | First Year Design Course, Sophomore Design Course | First Year Design Course | First Year Design Course, Possible Electives with Design | First Year Design Course, Junior Design course, Sophomore and Junior Design Electives |
| **Number of Capstone Students Annually** | 375-425 | 100-150 | 25-35 | 200-250 |
| **Number of Capstone Projects Annually** | 50-60 | 16-22 | 6-9 | 25-45 |
| **Project Sources Annually** | Industry: ~30%<br>Faculty: ~35%<br>Competition: ~20%<br>Humanitarian: ~15% | Industry: ~35%<br>Government: ~20%<br>Faculty: ~35%<br>Competition: <10%<br>Entrepreneurial: <10% | Industry: ~85%<br>Government: ~15% | Industry: ~85%<br>Government: <10%<br>Faculty: <5%<br>Competition: <5% |

*Recruitment*

Participants were recruited through their capstone courses during the spring semester each year. Recruitment included in-person or video conference visits to courses and team meetings by members of the research team,, followed by an email inviting participants to complete a screening survey (Appendix B: Screening Survey) that captured basic demographic information and career plans (e.g. whether participants had secured post-graduation employment as well as company size and major industry of their future employer).

*Sample Characteristics*

A total of 140 students were recruited to the study (66 in Cohort 1; 74 in Cohort 2) and were interviewed at the end of their spring semester just prior to graduation. Of those, 119 provided starting dates for work; and 7 entered graduate school; the remainder did not participate in further data collection. Note that not all participants completed all questions on the screening survey.

- Of the 126 who provided work or graduate school start date information, 53 (42%) self-identified as female on the screening survey (which included non-binary options). While no participant reported a change in gender identity during subsequent data collection, we did not explicitly solicit this information after the initial screening survey.
- The screening survey asked participants to self-identify their race/ethnicity. 81 participants identified as White or Caucasian; 21 participants reported identities from countries located in Asia; 10 participants chose not to answer. The remaining participants identified racial or ethnic affiliations typically considered underrepresented in engineering, including Latinx, Hispanic, African-American, and Black, as well as regional (e.g. Middle Eastern) or nation-specific identities. Given the small number of participants in these groups, participants' self-selected descriptors, and the desire to avoid imposing arbitrary aggregations, we do not report race or ethnicity further. Researchers who are interested in exploring the data along racial or ethnic categories should contact Marie Paretti (mparetti@vt.edu).
- 109 participants reported having prior work experience ("internship, co-op, or other work experience").

## Data Collection

*Instruments*

This study collected the following forms of data:

1. Quantitative surveys administered weekly during participants' first twelve weeks elicited activities the participants had engaged in at work and their perceive preparedness for those activities. Surveys were administered using Qualtrics[xm] (https://www.qualtrics.com/).
2. Qualitative surveys administered weekly during participants' first twelve weeks of work elicited details about participants' most significant challenge or accomplishment over the past week, along with the extent to which their capstone course played a role in that experience. Email was used to send the questions and receive the responses.
3. Semi-structured interviews prior to graduation explored participants' experiences in their capstone courses and their expectations about work.
4. Semi-structured interviews at three points during their first year of work (after approximately 3, 6, and 12 months of work) explored participants' experiences of the transition from school to work in depth.
5. Semi-structured follow-up interviews with female participants from Cohort 1 explored participants' experiences during their second year of work. These interviews were added to the project after the first year based on initial findings and were supported by supplemental funding from the National Science Foundation.

Appendix C: Weekly Survey Protocols provides the questions used in the quantitative and qualitative surveys. Appendix D: Interview Protocols provides the protocols used in the semi-structured interviews.

Data collection was conducted by members of the research team who were not participants' capstone course instructors.

*Compensation*
Participants received Amazon gift cards for completing interviews ($25/ interview) and surveys ($6.25/survey).

*Retention*
Given the intensive nature of the data collection and the competing demands on the time of working professionals, we allowed individuals to skip data collection points and prorated payment accordingly as a means to maximize retention through the full year of the study. Survey payments were prorated based on the number of surveys completed ($6.25/survey, paid every four weeks). Interviews were paid individually at the time of each interview.

Unless a participant explicitly discontinued participation (e.g. through an email indicating they no longer wanted to be contacted), they received an invitation for each data collection point regardless of whether they completed the previous data collection point. For example, even if a participant did not return a quantitative or qualitative survey in Week 3; they still received those surveys in Week 4. Similarly, even if they did not participate in an interview after 3 months of work, they received an invitation to participate in the 6-month interview. While this approach resulted in gaps in the data for individual participants, it yielded a relatively high retention rate overall: 76 participants (54% of the initial pool) completed the 12-month interview.

Table 2 summarizes the number of participants who provided responses for each of the data collection points. Appendix E: Data Collection Summary provides a complete summary of the data collected, including the total number of quantitative and qualitative survey responses and the available data for each participant.

Table 2: Number of Participants Providing Data By Instrument

| Site | Anticipatory Interviews | Work/ Grad School Start Date | Quantitative Survey Respondents | Qualitative Survey Respondents | 3-Month Interview | 6-Month Interview | 12-Month Interview |
|---|---|---|---|---|---|---|---|
| **Site A** | 40 | 39 | 39 | 36 | 32 | 27 | 24 |
| **Site B** | 38 | 35 | 30 | 29 | 20 | 21 | 20 |
| **Site C** | 26 | 25 | 24 | 21 | 15 | 20 | 15 |
| **Site D** | 36 | 27 | 26 | 24 | 20 | 18 | 17 |
| ***All Sites*** | *140* | *126* | *119* | *110* | *87* | *86* | *76* |
| **Female** | 56 | 53 | 52 | 48 | 35 | 38 | 31 |

## Data Analysis
Approaches to analyzing the quantitative survey data are available in publications resulting from this project. (to date: Deters et al., 2020; Ford et al., 2019; Howe et al., 2018).

*Qualitative Code Book*
The qualitative data, including both the reflective survey responses and the interviews, were analyzed using both *a priori* and emergent codes (Miles et al., 2014). The *a priori* coding scheme was based on Lutz and Paretti's study of capstone design (Lutz & Paretti, 2017), which identified four categories of student-reported outcomes: engineering design, teamwork and communication, self-directed learning, and engineering identity. Definitions for these categories were tested and refined using the data from the C2W study, and two new categories emerged. Key changes are as follows:

- *Engineering Design* was changed to *Technical Work* to better capture the full range of activities our participants engaged in
- *Adulting* emerged as a new category to capture the ways in which participants experienced issues of work/life balance and non-work tasks (e.g. buying insurance).
- *Strategies* emerged to identify the activities or approaches participants used in meeting challenges or performing effectively at work.

Table 3 summarizes these definitions for these categories as of February 2021.

Table 3: Emerging Themes from Qualitative Data Analysis

| **Category** | **Definition: Activities associated with …** |
|---|---|
| **Adulting** | …being an independent adult, including balancing personal and professional aspects of life as well as specific challenges associated with life outside of work. |
| **Engineering Identity** | …seeing oneself as an employee and/or engineer |
| **Self-Directed Learning** | …managing and monitoring one's own activities at work, including time, attention, and knowledge |
| **Strategies** | … steps participants took to meet challenges or engage more effectively in work. |
| **Teamwork & Communication** | …working in teams or communicating clearly, including formal and informal communication as well as interpersonal relationships |
| **Technical Work** | … technical engineering work, including design, analysis, testing, software, and equipment |

Within each category, we also developed emergent codes to capture a more detailed understanding of participants' experiences. These subcodes are detailed in Appendix F: Full C2W Codebook.

In addition to coding the activities used the categories in Table 3 and the subcodes in Appendix F, we also coded them according to type, as listed in Table 4.

Table 4: C2W Activity Type Codes

| **Type Code** | **Code Definition** |
|---|---|
| **Accomplishment** | The participant is describing the activity as a significant accomplishment. |
| **Capstone Advice** | The participant is providing advice for the capstone course (e.g., to better align it with work) |
| **Challenge** | The participant is describing the activity as something they found challenging |
| **Difference** | The participant describes the activity in terms of a difference between school and work |
| **Strategy** | The participant is describing the activity as a strategy they used to meet a challenge or succeed at a task |
| **Successful Transfer from Capstone** | The participant describes the activity in terms that indicate transfer of learning from capstone to the workplace - i.e. the experiences are similar, or the participant used knowledge from capstone in the workplace |
| **Workplace Experience or Event** | The participant is describing an event or experience that happened at work, without suggesting that it was a challenge or an accomplishment. |

*Codebook Development*

Qualitative coding was an iterative process that began with the qualitative survey responses and continued through the interview coding. Several members of the research team began by applying the *a priori* codes from Lutz and Paretti (Lutz & Paretti, 2017) to the qualitative survey data from

Cohort 1; through this process emergent category codes and subcodes were identified. These codes and their definitions were then refined iteratively as coding progressed through the Cohort 1 qualitative surveys and interviews, and subsequently the Cohort 2 data.

Several features of the data collection and coding process support to the overall trustworthiness of the analysis:

- The primary coders were graduate and undergraduate research assistants who were not involved in teaching the capstone courses.
- Throughout data analysis, new coders were trained by experienced coders, with regular reviews of coding and group norming sessions to discuss code definitions.
- Norming sessions were led either by more experienced coders or by the lead institution PI (Paretti), who was not involved in teaching any of the capstone courses from which participants were drawn.
- All project PIs and collaborators participated periodically in the code definition discussions as part of biweekly project meetings.
- All project PIs and collaborator Ott conducted a code review at the conclusion of Cohort 1 data collection in which they reviewed a subset of excerpts assigned to a given code to check for coherence of the code definitions and consistency of the code applications.

*Software*

All coding was done using the qualitative coding platform Dedoose (http://www.dedoose.com). Code reviews were done using both Dedoose and spreadsheets (Microsoft Excel and Google Sheets). Dedoose was used to review coding of individual documents (for example, when training new coders to make sure they identified all relevant excerpts in an interview). Excerpts were exported to Excel and Google Sheets to facilitate the review of all excerpts tagged with a given code to ensure coherence of the code definitions and consistency of the code applications.

*Code Application*

The qualitative survey responses from Cohort 1 (the first set of qualitative data obtained) were coded slightly differently than the remaining data. Because the Cohort 1 qualitative survey asked only about challenges participants experienced, this data was coded using only the categories listed in Table 3 and their associated subcodes; this coding focused only on challenges and strategies for meeting those challenges. Every activity not under the *Strategy* category in that data set is automatically of the *Type* code *Challenge*. In that initial coding, *Transfer from Capstone* (initially named *Draw on Capstone*) was considered a subcode under *Strategies*; in the subsequent version of the codebook, this subcode was moved to the *Type* category, though its definition did not change.

**Limitations**

As with any study, while our approach to data collection yielded valuable qualitative descriptions of participants' experiences, the data are limited in multiple ways.

- As noted, participants are drawn from three mechanical engineering programs and one engineering science program, and findings may not be fully transferable across all engineering disciplines or programs. (see Deters et al. (2020) for a cross-site analysis of the quantitative survey data).
- Participants in this study are self-selected and the pool may thus be biased toward students who are more inclined to be self-reflective and more interested in recording and learning from their experiences. They may also be participants who viewed their capstone

experiences positively, though the interviews conducted prior to graduation indicated that not all participants had positive team or project experiences (even if they perceived high value in the capstone course).

- Participating in the study may itself have influenced participants' transition experiences. By asking our participants to reflect on their challenges and strategies, our data collection tools inherently changed their experiences.
- As noted earlier, we allowed participants to stay in the study even if they missed individual surveys or interviews; while this resulted in gaps in the data for individual participants, overall participant response rates remained high, as did retention through the longitudinal study.

Despite these limitations, the richness and complexity of this data set has yielded critical insights into new engineers' initial transitions from school to work.

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**Appendix A: Capstone Design Learning Objectives from Four Sites**

Site A:

- Design mechanical and/or thermal systems using engineering, science, and mathematical methodologies. The design process includes the following steps: problem recognition and definition, concept generation and selection, building and testing of physical devices, design communication and review, and project management.
- Understand the following: team dynamics, ethical responsibilities of the engineer, generation and protection of intellectual property, professionalism in behavior and dress, and design documentation.

Site B:

- Gain a thorough overview of the design procedure that is followed by today's mechanical engineers.
- Obtain an understanding of design principles and practices that should assist them in making informed design decisions and in solving complex problems.
- Develop the framework for understanding how various mechanical engineering technologies are used in the design process.

Site C:

- Design an appropriate solution to a real-world engineering design problem
- Understand, apply, and manage the engineering design process
- Communicate effectively through oral, written, and visual means
- Work effectively as a member of a diverse team
- Exercise professional responsibility, ethical reasoning, and contextual awareness
- Evaluate academic experience and professional training in light of future career and educational goals

Site D:

- Develop an understanding of the necessary professional skills needed to succeed in industry
- Understand how to collaboratively work in a team toward a common design
- Become proficient at written technical communications
- Become proficient at oral technical communications
- Become proficient at managing long term projects
- Become proficient at integrating technical skills to successfully complete a project
- Develop the knowledge and ability to use skills in heat transfer, fluid mechanics, circuits, etc. to perform engineering analysis
- Generate alternative design concepts and evaluate using design requirements
- Apply engineering design skills to create CAD models and drawings to build professional prototypes
- Use results of engineering analysis to make decisions (engineering and business) in a methodical manner
- Fabricate and test physical prototypes to help make decisions

**Appendix B: Screening Survey**

1. Have you had an internship, co-op, or other work experience prior to graduation? (Yes/No)
2. Which capstone design project did you work on? (open-ended response)
3. Do you have a job lined up for after graduation (not including graduate school)? (Yes/No)

For participants with jobs

4. What employment sector are you working in? (select one)
    a. Automotive
    b. Consumer products
    c. Defense
    d. Aerospace
    e. Electronics
    f. Other (please explain)
5. When will you start working? (open-ended response)
6. What is the approximate size of the company in which you will be working?
    a. Small (less than 100 people)
    b. Medium (less than 1000)
    c. Large/Multinational

For participants without jobs

7. Are you planning to attend graduate school this fall?
    a. Yes (please specify where) (included open-ended response)
    b. No

For all participants

8. Last name:
9. First name:
10. Preferred email address:
11. Gender
    a. Male
    b. Female
    c. Transgender
    d. Gender non-conforming
    e. Other
    f. Prefer not to answer
12. Race/Ethnicity:
    a. Please describe in your own words (open-ended response)
    b. Prefer not to answer

**Appendix C: Weekly Survey Protocols**
Slight changes were made to the survey between the first and second cohorts, as indicated.

*Quantitative Survey (administered once per week for participants' first 12 weeks of work)*
The quantitative survey, informed by Experience Sampling Methodologies (ESM) (Hektner et al., 2006; Zirkel et al., 2015), asked participants to identify activities in which they had participated within the past week and rate their perceived preparedness for each relevant activity.

Cohort 1
The survey asks participants whether they have participated in each of the following activities during the past week:

- Holding team meetings within your unit or project team
- Project planning
- Writing reports
- Making or giving formal presentations
- Performing engineering calculations
- Generating or refining design concepts
- Prototyping and testing designs
- Modeling
- Meeting with clients
- Project Budgeting
- Other (please provide a short description)

Each time the participant selected yes for an activity, the survey asked them to rate their preparedness as follows:

To what extent did you feel prepared for the following activity: [activity name]?

- Completely unprepared
- Moderately unprepared
- Slightly unprepared
- Neither prepared nor unprepared
- Slightly prepared
- Moderately prepared
- Completely prepared

Cohort 2
The survey replicated the process used for Cohort 2 but added a new activity and revised the wording of several other activities. An item for training was added because that was the most frequently cited "other" activity identified from Cohort 1. Text was clarified based on interview responses.

- Attending training sessions or workshops – *New item*
- Developing project budgets or business financials – *Revised wording for clarity*
- Generating or refining design concepts
- Making or giving presentations – *Revised wording to capture both formal and informal presentations without increasing survey length further*

- Meeting with your unit or project team – *Revised wording for clarity*
- Meeting with clients
- CAD Modeling – *Revised wording for clarity*
- Performing engineering calculations
- Planning projects
- Prototyping or testing designs
- Writing reports
- Other (please provide a short description)

The prompt for perceived preparedness for each activity did not change; however, at the end of the survey, participants were asked a final overall question about preparedness:

> Finally, looking back at your week overall, how prepared did you feel for your job this week?

Answer options were identical to the activity preparedness options.

*Qualitative Survey (administered once per week for participants' first 12 weeks of work)*

Cohort 1
Participants in Cohort 1 received the same prompt each week:

> Think about your experiences over the past week at work.
>
> 1. What was your biggest challenge this week?
> 2. What made it so challenging?
> 3. How did you approach this challenge?
> 4. To what extent did you feel prepared for this challenge based on your capstone design experience? Based on other experiences?
> 5. Is there anything you think your education might have done that would have better prepared you?
> 6. Are there other workplace activities this week you felt particularly well or poorly prepared for? If so, please explain.

Cohort 2
Participants in Cohort 2 received alternating prompts by week to address perceive response fatigue seen in Cohort 1 (e.g. participants in Cohort 1 noting that they felt they had nothing new to say in certain weeks).

Weeks 1,3,5,7,9,11

> Think about your experiences over the past week at work.
>
> 1. What was your biggest challenge this week?
> 2. What made it so challenging?
> 3. How did you approach this challenge? Reflecting on it now, do you wish you had handled it differently?

4. To what extent did you feel prepared for this challenge based on your capstone design experience? Based on other experiences?
5. Is there anything you think your education might have done that would have better prepared you?
6. Are there other workplace activities this week you felt particularly well or poorly prepared for? If so, please explain.

Weeks 2,6,10

Think about your experiences over the past week at work.

1. What was your most significant accomplishment this week?
2. What made it significant?
3. Did anyone help you in achieving this accomplishment?
   How did they help?
4. To what extent did you feel prepared for this accomplishment based on your capstone design experience? Based on other experiences?
5. Are there other workplace activities this week you felt particularly well or poorly prepared for? If so, please explain.

Weeks 4, 8, 12

Identical to weeks 2, 6, and 10, but with the following questions added:

*At the beginning:* Have there been any major changes in your job over the past month? If so, what?

*At the end:* Looking back over the last month, were there any things in particular you did or experienced that really made you see yourself as an engineer?

**Appendix D: Interview Protocols**
Interviews followed the protocols below, but were semi-structured to allow for flexibility and exploration of potentially salient but unanticipated topics. The exact language shifted as needed in the course of the interview to create a smooth flow of conversation.

*Interview Protocol #1 – Anticipatory (pre-graduation)*
Changes made between cohorts are noted where appropriate

Introduction: As I mentioned when we reviewed the informed consent, what I'm really interested in today is your experience in your capstone design course, what you've learned here, and how you see it fitting in to your future plans.

1. I'd like to start by understanding your project, so can you tell me about your project? If they don't mention it, probe for the following:
   - How the project developed over the year/semester
   - Role of capstone advisor in terms of frequency of meetings and level of involvement
   - Role of project director/industry mentor/sponsor
   - Your role in the project
   - Changes to your own role over time
2. (Cohort 2 only) What was your most significant accomplishment on this project? What made it significant?
3. What was your biggest challenge on this project, and how did you deal with that challenge?

Now I'd like to step back again and understand a little more about what you believe you've learned from the project.

4. More broadly, what are the most valuable things you believe you've learned from this project?
   a. How did you learn that?
   b. How do you think you've developed as a result of your capstone experience?
5. (Cohort 2 only) "Engineering" is a really broad term that can mean so many different things to different people.
   a. Based on your experience so far, how would you describe what it means to be an engineer and what engineers do?
   b. In light of what you just said, to what extent do you see yourself as an engineer at this time? Why? Probe for specific experiences in capstone, but also any other experiences (internships, extracurricular activities, other courses, etc.)

Now I'd like to talk about your next steps.

6. What do you plan on doing when you graduate?

(Cohort 2 only) If they have a job, ask the following.

   a. Why did you choose that job?
   b. How does that job connect to the description of engineering you just provided?
   c. [If they got the job between the recruitment survey and the interview]: How big is the company and how would you describe the work

i. What size company do you work for? (a) <100 employees, 100-1000 employees, >1000 employees - large multinational
ii. What industry are you in: Aerospace, Defense, Automotive, Consumer Products, Electrical/Electronics, Energy, Biomedical or Pharmaceutical, Civil /Infrastructure, Environmental, Consulting, Other

If they don't have a job: What types of jobs are you looking for?

7. What kinds of skills do you think will be important as you start a job?

8. In what ways do you think capstone/senior design prepared you for this job? Probe for expected similarities and differences between capstone and work. E.g. What similarities and differences do you expect between capstone and work?

9. When you think about this job, what are you excited about?
    a. Nervous about? Why?
    b. Unsure about? Why?

10. On a 1-10 scale, how prepared do you feel to start your job?
    (Cohort 2: Prompt revised to 1-7 and numbers were anchored to the same text used in the weekly surveys)
    a. Can you explain your answer?
    b. (Cohort 2 only) How prepared do you expect to feel?
    c. (Cohort 2 only) Is there anything that you still feel like you need to learn or wish you had learned?
11. Is there anything else you want to add about your experience in capstone design that you think we should know?

The next section of the interview will involve the researcher explaining the terms and expectations for participation, making sure the participant is aware of the overall plan. The researcher will describe the data collection plan for the next 12 weeks, including when emails will be sent, what will be asked, and how to respond. The researcher will explain the compensation process, and explain how gift cards will distributed. The researcher will discuss issues of privacy and confidentiality, ensuring participants understand the researchers are not associated with their company and will not contact others within their organization. The researcher will also attempt to establish rapport with participants, explaining to them that they are co-researchers in this endeavor while, and elaborating on their importance in the study. This will also be an attempt to increase their level of investment and reduce participant fatigue and attrition. Interview will conclude with participants signing the informed consent form for the weekly survey prompts.

(For Cohort 2, the following information was added to the instructions for interviewers) The researcher will show participants the two short surveys and talk through the items. The researcher will also emphasize that even if things are the same this week as a previous week, our team still wants to know that - we're really excited about their work experiences even when they don't change. The researchers will mention that we're also interested in what participants do even if their weekly activities don't seem like engineering to them, don't match items on the short survey, or are really different from what they expected. The researcher will also note that the scale of the quant survey is the same one we talked about in this interview in terms of their perceived level of preparation.

(Cohort 2) 12. Do you have any questions for me?

*Interview Protocol #2 – Early Employment (3, 6, and 12 months)*
Although the scope and intent of the protocols remained consistent across cohorts, the research team made significant refinements in language, structure, and focus to the early employment protocols that, unlike the changes to the anticipatory interview protocol, are not readily captured by simply noting the changes. We thus present both complete protocols here.

Cohort 1
Introduction: As I mentioned when we reviewed the informed consent, what I'm really interested in today is exploring your recent experiences in your job and how they might relate to your capstone design experience.

1. Tell me a little bit about your job.
    a. What are your typical responsibilities?
    b. On a scale of 1-10, how prepared do you feel for these responsibilities?
    c. Please explain your rating. (Prompt participant to discuss capstone course versus other sources of preparation)
2. How much or what kind of training have you received for this work?
    a. If they had training: Tell me a little bit about that experience?
3. How do your work responsibilities compare to what you experienced in your capstone course?
    a. In what ways were you experiences aligned with your capstone course?
    b. In what ways were they different?
4. Thinking broadly, what has been challenging about this new job?
    a. What do you think makes that so challenging?
    b. How are you dealing with those challenges?
    c. In what ways did your capstone experience prepare you for those challenges? [Anywhere else?]
5. *[Referencing short surveys] What skills have been necessary for you to do your job? Where did you develop those skills?
    a. Can you elaborate on those skills as they happened at work?
6. Based on your experiences so far, can you provide a definition or description of engineering work?

Now I'd like to talk in a little bit more detail about some things that you described in your weekly responses:

7. Based on [interesting survey response or prior interview comments], it looks like [this time] was pretty important for your transition. Can you elaborate a bit more on what was going on then?
    a. Researcher will have participant-specific prompts based on journal entries

Now I'd like to step back a little and talk more broadly about the transition from your capstone/senior design class to work.

8. Knowing what you know now, is there anything that you wish you would have learned about in capstone?
    a. Why would that have been important?
    b. Was there anything in capstone that you would take out or change?
9. If you could give advice to the next class of graduating seniors about what to expect when they enter their jobs, what would that be?

10. If you could give any advice to your capstone design instructor - including not only what to change, but what to keep doing - what would you say?

I'd like to shift gears a little bit now and talk about some logistical issues.

11. How was the process of responding to either survey? Was it boring? Worthwhile? What motivated you to respond?
12. Did you receive performance reviews from a supervisor?
    a. Would you be comfortable sharing those performance reviews with us or describing the feedback?

13. Thank you for your time, is there anything else you would like to add that we maybe haven't covered, as I try to understand how individuals experience this transition from school to work?

Cohort 2
Introduction: As I mentioned when we reviewed the informed consent, what I'm really interested in today is exploring your recent experiences in your job and how they might relate to your capstone design experience.

6- and 12-month interviews (ONLY): I'm going to start by asking you more or less the same questions I asked in our previous interview. If things are the same, I'd still like to hear about them, but I'm especially interested in things that have changed since the previous interview.

I'd like to start by learning a little bit more about your job.

1. (At 3 month-interview ONLY) [If they had a job at graduation]: In the recruitment survey/first interview, you thought you'd be working for an X-size company in X industry. Is that still correct? If not, what's different?
   [If participant didn't have a job at graduation, now ask the following:
    a. What size company do you work for? (a) <100 employees, 100-1000 employees, >1000 employees - large multinational
    b. What industry are you in: Aerospace, Defense, Automotive, Consumer Products, Electrical/Electronics, Energy, Biomedical or Pharmaceutical, Civil /Infrastructure, Environmental, Consulting, Other (can select multiple)

2. Tell me a little bit about your job.
    a. What are your typical responsibilities? [6- and 12-month ONLY]: Has this changed much in the last 3 months?
    b. What does a typical week look like for you? What kinds of tasks and activities do you do? Who do you interact with?
    c. [3-month interview only] Using the same scale we used in the weekly surveys, on a scale of 1-7, how prepared do you feel for your responsibilities?
    d. What aspects of your job have you felt the most prepared for over the past 3 months? Why or how?
    e. What aspects of your job have you felt least prepared for over the past 3 months? Why or how?

3. What skills have been necessary for you to do your job?
    a. Where did you develop those skills?
    b. How much or what kind of training have you received from your employer for this work?
    c. If they had training: Tell me a little bit about that experience?

4. Thinking broadly, what has been your most significant accomplishment at work over the past 3 months?
    a. What made it so significant?
    b. In what ways did your capstone experience prepare you for that accomplishment? In what ways did other experiences prepare you (internships, extracurricular activities, other classes, etc.)

5. Thinking broadly, what has been most challenging about your job over the past 3 months?
    a. What do you think made that so challenging?
    b. How have you dealt/are you dealing with that challenge?
    c. In what ways did your capstone experience prepare you for that challenges? In what ways did other experiences prepare you (internships, extracurricular activities, other classes, etc.)

Now I'd like to talk a little bit about how your job compares to your past experiences and expectations.

6. First, how do your work responsibilities compare to what you experienced in your capstone course?
    a. In what ways were your experiences aligned with your capstone course?
    b. In what ways were they different?

7. How did your experiences at work match your initial expectations? (Have notes in from the anticipatory interview as prompts for those expectations)

8. At your previous interview, we talked about how you define engineering.
    a. Based on your experience so far, how would you now describe what it means to be an engineer and what engineers do?
    b. In light of what you just said, to what extent do you see yourself as an engineer at this time? Why? Probe for specific experiences at work that do/do not seem like engineering.
    c. One of the things that undergraduate programs often address are the "broader impacts" of engineering work - e.g. social, economic, political, or cultural issues. Do you see any factors like these impacting your engineering work?

[3-month interview ONLY] Now I'd like to talk in a little bit more detail about some things that you described in your weekly responses:

9. Based on [interesting survey response or prior interview comments], it looks like [this time] was pretty important for your transition. Can you elaborate a bit more on what was going on then?

a. Researcher will have participant-specific prompts based on journal entries

Now I'd like to step back a little and talk more broadly about the transition from your capstone/senior design class to work.

10. Knowing what you know now, is there anything that you wish you would have learned about in capstone?
    a. Why would that have been important?
    b. Was there anything in capstone that you would take out or change?

11. If you could give advice to the next class of graduating seniors about what to expect when they enter their jobs, what would that be?
    a. Why would that advice be useful?
    b. Would you have listened to that advice?

12. If you could give any advice to your capstone design instructor - including not only what to change, but what to keep doing - what would you say?

13. (6 and 12 month ONLY) Did you receive performance reviews from a supervisor?
    a. Would you be comfortable describing the feedback you received? (If so, please do)

(12 month interview ONLY) Now that we're at the end of this study, we'd like you to take a step back and think more broadly about your company and broader work context this year.

14. How would you describe the culture of your organization? What's your workplace environment like?
15. How did your understanding of the broader context of your work/your company evolve over the past year?
    a. To what extent were you aware of this bigger picture when you started?
    b. How has your work been impacted by this bigger picture? How have you had to adapt to work in a larger context?
    c. Are there any ways you think capstone design could have prepared you to recognize and to adapt to this environment? Why or why not?

16. Thank you for your time, is there anything else you would like to add that we maybe haven't covered, as I try to understand how individuals experience this transition from school to work?

*Interview Protocol #3 – Year 2 Followup*

The following protocol was used with females from Cohort 1; of the 29 females from that cohort who participated in anticipatory interviews, 15 participated in interviews during their second year of work. As with the previous protocols, the interview was semi-structured and language and flow adapted to maintain the conversation.

Introduction: As I mentioned when we reviewed the informed consent, what I'm really interested in today is exploring your recent experiences in your job and how they might relate to your capstone design experience.

I'm going to be asking you many of the same questions I asked in our previous interviews. If things are the same, I'd still like to hear about them, but I'm also interested in things that have changed since the previous interview. I'll also be asking a few new questions.

1. To start, tell me a little bit about your job now.
    a. Have your responsibilities changed much in the last year?
    b. What does a typical week look like for you? What kinds of tasks and activities do you do? Who do you interact with?
    c. Could you talk more specifically about communication, and the role it plays in your job?

2. What skills are necessary for you to do your job at this point?
    a. Are these different from your first year?
    b. Where did you develop those skills?
    c. How much or what kind of training have you received from your employer for this work?
    d. If they had training: Tell me a little bit about that experience?
    e. Are there skills that you feel you are missing for you to effectively do your work?

3. What are your feelings regarding work?
    a. How prepared do you feel doing what you do?
    b. Are there things that make you feel excited, or alternatively, nervous?
    c. Do you feel like you have job security?

4. Can you talk about a significant accomplishment at work over the past year?
    a. Could you talk about a significant challenge you've faced over the past year?
    b. Does capstone have anything to do with these experiences?
    c. If yes, what does capstone have to do with that experience?

Now I'd like to talk a little bit more about capstone.

5. Capstone was a while ago now. What are your thoughts and feelings about it, looking back?
    a. How well did your capstone course prepare you for your current work?
    b. How does the engineering you did in Capstone compare to what you do now? Similarities and differences?
    c. Is there anything you feel was missing from Capstone?
    d. Anything missing from your education in general?

6. How do your experiences at work match your initial expectations? (Have notes from previous interviews regarding expectations)

7. In previous interviews, we talked about how you define engineering.
    a. Could you describe what it means to be an engineer and what engineers do? What kinds of problems do engineers solve?
    b. In light of what you just said, to what extent do you see yourself as an engineer at this time?
    c. Can you give me an example of something that you do that is engineering?
    d. If they don't feel like their work is engineering: Why not?

        i. Follow up: Is there someone in your office/at work who you do consider an engineer or who is doing engineering work? Why?
    e. One aspect of engineer that is often discussed is the social impacts of engineering. Do you think your work has social impacts? Do you think any social factors impact the way you do your work?

8. We've been talking a lot about being an engineer, but each of us has other parts of our identities - for example, family relationships, relationship status, race, religion, culture, gender, interests.
    a. How do any of these other aspects of who you are intersect with your work as an engineer?
    b. If they don't mention gender: how does your gender intersect with your engineering work?

9. Based on [prior interview comments], it looks like [this event] is pretty important for us to discuss. How have things played out since then?
    a. Why do you think they played out that way?
    b. Does this relate to the culture of your company more broadly? If so: how?

10. If you could give advice to the next class of graduating women in engineering about what to expect when they enter their jobs, what would that be?
    a. Why would that advice be useful?
    b. Would you have listened to that advice? Why or why not?

11. If you could give any advice to your capstone design instructor - including not only what to change, but what to keep doing - what would you say?

12. Have you received any performance reviews from a supervisor or manager?
    a. Would you be comfortable describing the feedback you received, positive and negative? (If so, please do)

13. Thank you for your time, is there anything else you would like to add that we maybe haven't covered, as I try to understand how individuals experience this transition from school to work?

## Appendix E: Data Collection Summary

Note that to preserve participant confidentiality, demographic data is not included for individual participants and overall patterns are noted for women only. Researchers interested in exploring demographic variations should contact the research team

*Summary*

| Site | Anticipatory Interviews | Work/Grad School Start Date | Quantitative Survey Respondents | Qualitative Survey Respondents | 3-Month Interview | 6-Month Interview | 12-Month Interview |
|---|---|---|---|---|---|---|---|
| All participants | | | | | | | |
| Site A | 40 | 39 | 39 | 36 | 32 | 27 | 24 |
| Site B | 38 | 35 | 30 | 29 | 20 | 21 | 20 |
| Site C | 26 | 25 | 24 | 21 | 15 | 20 | 15 |
| Site D | 36 | 27 | 26 | 24 | 20 | 18 | 17 |
| *Total* | *140* | *126* | *119* | *110* | *87* | *86* | *76* |
| Female | 56 | 53 | 52 | 48 | 35 | 38 | 31 |
| Workplace Only (i.e. Excludes participants who went to graduate school) | | | | | | | |
| Site A | 39 | 38 | 38 | 35 | 31 | 26 | 23 |
| Site B | 35 | 32 | 27 | 26 | 17 | 18 | 17 |
| Site C | 25 | 24 | 23 | 21 | 15 | 20 | 15 |
| Site D | 33 | 25 | 24 | 23 | 19 | 17 | 16 |
| *Total* | *132* | *119* | *112* | *105* | *82* | *81* | *71* |
| Female | 54 | 51 | 50 | 47 | 34 | 37 | 30 |

*Quantitative and Qualitative Survey Response Counts*

| Survey Summary | All participants | Workplace Participants Only* |
|---|---|---|
| Total Quantitative Surveys | 1089 | 1033 |
| Total Qualitative Surveys | 1001 | 956 |
| Ave. Quant/Week | 45 | 43 |
| Ave. Qual/Week | 42 | 40 |

| | | Quantitative Surveys | | Qualitative Surveys | |
|---|---|---|---|---|---|
| | | All participants | Workplace Participants Only* | All participants | Workplace Participants Only* |
| Average per participant (for those completing at least 1) | | 9 | 9 | 9 | 9 |
| Number of participants completing … | | | | | |
| | >10 | 52 | 50 | 57 | 54 |
| | 8 to 10 | 35 | 32 | 27 | 27 |
| | 6 or 7 | 13 | 13 | 6 | 4 |
| | <6 | 19 | 17 | 20 | 20 |

*Data By Participant*

To ensure participant confidentiality, the table below does not provide demographic data. Researchers interested in exploring the data based on demographic variables should contact Marie Paretti (mparetti@vt.edu). Missing data is highlighted in gray.

| Participant Number | Provided Work Start Date | No. Quant surveys completed | No. Qual surveys completed | Completed 3-month Interview | Completed 6-month Interview | Completed 12-month Interview |
|---|---|---|---|---|---|---|
| 1 | Y | 8 | 10 | Y | Y | Y |
| 2 | Y | 10 | 12 | Y | N | Y |
| 3 | Y | 3 | 4 | N | N | N |
| 4 | Y | 12 | 10 | Y | Y | Y |
| 5 | Y | 12 | 11 | Y | Y | Y |
| 6 | Y | 8 | 7 | Y | N | N |
| 7 | Y | 11 | 11 | Y | Y | Y |
| 8 | Y | 10 | 10 | Y | N | N |
| 9 | Y | 12 | 8 | Y | N | N |
| 10 | Y | 11 | 12 | Y | Y | Y |
| 11 | Y | 12 | 12 | Y | Y | Y |
| 12 | Y | 12 | 10 | Y | Y | Y |
| 13 | Y | 12 | 12 | Y | Y | Y |
| 14 | Y | 12 | 11 | Y | NR | N |
| 15 | Y | 12 | 9 | Y | Y | Y |
| 16 | Y | 12 | 12 | Y | Y | Y |
| 17 | Y | 7 | 0 | N | N | N |
| 18 | Y | 12 | 8 | Y | Y | N |
| 19 | Y | 11 | 10 | Y | Y | N |
| 20 | Y | 5 | 0 | N | N | N |
| 21 | X | 0 | 0 | N | N | N |
| 22 | Y | 8 | 5 | Y | N | Y |
| 23 | Y | 2 | 2 | N | N | N |
| 24 | Y | 12 | 10 | Y | Y | Y |
| 25 | Y | 11 | 11 | Y | Y | Y |
| 26 | Y | 10 | 11 | Y | Y | Y |
| 27 | Y | 12 | 12 | N | N | N |
| 28 | Y | 1 | 1 | N | N | N |
| 29 | Y | 10 | 6 | Y | Y | Y |
| 30 | X | 0 | 0 | N | N | N |
| 31 | Y | 12 | 10 | Y | Y | Y |
| 32 | Y | 12 | 12 | Y | Y | Y |
| 33 | Y | 12 | 12 | Y | Y | Y |
| 34 | Y | 5 | 2 | N | N | N |
| 35 | Y | 10 | 12 | Y | Y | Y |
| 36 | Y | 7 | 6 | Y | Y | Y |
| 37 | Y | 2 | 2 | N | N | N |
| 38 | Y | 10 | 12 | Y | Y | Y |

| Participant Number | Provided Work Start Date | No. Quant surveys completed | No. Qual surveys completed | Completed 3-month Interview | Completed 6-month Interview | Completed 12-month Interview |
|---|---|---|---|---|---|---|
| 39 | Y | 8 | 9 | Y | N | N |
| 40 | Y | 10 | 0 | N | N | N |
| 41 | X | 0 | 0 | N | N | N |
| 42 | Y | 12 | 11 | Y | Y | Y |
| 43 | Y | 10 | 12 | Y | Y | Y |
| 44 | Y | 4 | 10 | Y | Y | Y |
| 45 | Y | 12 | 4 | Y | Y | Y |
| 46 | Y | 7 | 12 | Y | Y | Y |
| 47 | Y | 12 | 11 | Y | Y | N |
| 48 | Y | 12 | 12 | Y | Y | Y |
| 49 | Y | 2 | 0 | N | N | N |
| 50 | Y | 5 | 1 | Y | Y | N |
| 51 | Y | 7 | 0 | N | Y | N |
| 52 | Y | 10 | 7 | Y | Y | Y |
| 53 | Y | 9 | 9 | Y | Y | Y |
| 54 | Y | 10 | 10 | Y | Y | N |
| 55 | Y | 9 | 8 | N | N | N |
| 56 | Y | 10 | 8 | Y | Y | Y |
| 57 | Y | 10 | 9 | N | N | N |
| 58 | X | 0 | 0 | N | N | N |
| 59 | Y | 12 | 11 | Y | Y | Y |
| 60 | Y | 8 | 0 | Y | Y | Y |
| 61 | Y | 10 | 8 | Y | Y | Y |
| 62 | Y | 12 | 11 | Y | Y | Y |
| 63 | Y | 12 | 12 | Y | Y | Y |
| 64 | Y | 10 | 12 | Y | Y | Y |
| 65 | Y | 12 | 10 | Y | Y | Y |
| 66 | Y | 3 | 2 | Y | Y | Y |
| 67 | Y | 2 | 2 | Y | Y | Y |
| 68 | Y | 11 | 9 | N | Y | Y |
| 69 | Y | 12 | 11 | Y | Y | Y |
| 70 | Y | 6 | 1 | N | N | N |
| 71 | Y | 12 | 12 | Y | Y | Y |
| 72 | Y | 10 | 9 | Y | Y | Y |
| 73 | Y | 12 | 12 | Y | Y | Y |
| 74 | X | 0 | 0 | N | N | N |
| 75 | Y | 6 | 5 | N | Y | N |
| 76 | Y | 6 | 11 | Y | Y | Y |
| 77 | Y | 12 | 12 | Y | N | N |
| 78 | Y | 12 | 11 | Y | Y | N |
| 79 | Y | 12 | 12 | Y | Y | Y |
| 80 | Y | 3 | 0 | N | N | N |
| 81 | Y | 9 | 6 | Y | Y | Y |
| 82 | Y | 12 | 11 | Y | Y | Y |

| Participant Number | Provided Work Start Date | No. Quant surveys completed | No. Qual surveys completed | Completed 3-month Interview | Completed 6-month Interview | Completed 12-month Interview |
|---|---|---|---|---|---|---|
| 83 | Y | 12 | 12 | Y | Y | Y |
| 84 | Y | 10 | 11 | Y | N | N |
| 85 | Y | 10 | 9 | Y | Y | Y |
| 86 | Y | 6 | 8 | Y | Y | Y |
| 87 | Y | 12 | 12 | Y | Y | Y |
| 88 | Y | 0 | 0 | N | N | N |
| 89 | Y | 12 | 11 | N | Y | N |
| 90 | Y | 0 | 0 | N | N | N |
| 91 | Y | 9 | 11 | Y | Y | Y |
| 92 | Y | 12 | 11 | N | N | N |
| 93 | Y | 0 | 0 | N | Y | N |
| 94 | Y | 12 | 12 | Y | Y | Y |
| 95 | Y | 4 | 4 | N | Y | Y |
| 96 | Y | 8 | 12 | Y | Y | Y |
| 97 | Y | 12 | 12 | Y | Y | Y |
| 98 | Y | 12 | 10 | Y | Y | Y |
| 99 | Y | 12 | 12 | Y | Y | Y |
| 100 | X | 0 | 0 | N | N | N |
| 101 | Y | 8 | 8 | Y | Y | Y |
| 102 | Y | 0 | 0 | N | N | N |
| 103 | Y | 6 | 3 | N | N | N |
| 104 | Y | 7 | 12 | N | Y | Y |
| 105 | Y | 10 | 10 | Y | Y | Y |
| 106 | Y | 12 | 12 | Y | Y | Y |
| 107 | Y | 11 | 12 | N | Y | Y |
| 108 | Y | 9 | 12 | Y | Y | Y |
| 109 | Y | 12 | 12 | N | Y | N |
| 110 | Y | 0 | 0 | N | N | N |
| 111 | Y | 11 | 12 | Y | Y | Y |
| 112 | X | 0 | 0 | N | N | N |
| 113 | Y | 9 | 6 | N | Y | N |
| 114 | Y | 12 | 12 | Y | Y | Y |
| 115 | Y | 6 | 0 | N | Y | N |
| 116 | Y | 3 | 3 | N | N | N |
| 117 | Y | 12 | 12 | Y | N | Y |
| 118 | Y | 6 | 11 | N | N | N |
| 119 | Y | 4 | 1 | Y | N | N |
| 120 | Y | 11 | 12 | Y | Y | Y |
| 121 | X | 0 | 0 | N | N | N |
| 122 | Y | 12 | 12 | Y | Y | Y |
| 123 | Y | 11 | 11 | Y | Y | Y |
| 124 | Y | 4 | 4 | N | N | N |
| 125 | X | 0 | 0 | N | N | N |
| 126 | Y | 10 | 11 | Y | Y | Y |

| Participant Number | Provided Work Start Date | No. Quant surveys completed | No. Qual surveys completed | Completed 3-month Interview | Completed 6-month Interview | Completed 12-month Interview |
|---|---|---|---|---|---|---|
| 127 | X | 0 | 0 | N | N | N |
| 128 | Y | 0 | 5 | N | N | N |
| 129 | Y | 8 | 0 | Y | N | N |
| 130 | X | 0 | 0 | N | N | N |
| 131 | Y | 7 | 9 | N | N | N |
| 132 | X | 0 | 0 | N | N | N |
| 133 | Y | 2 | 0 | N | N | N |
| 134 | X | 0 | 0 | N | N | N |
| 135 | X | 0 | 0 | N | N | N |
| 136 | Y | 10 | 11 | Y | Y | Y |
| 137 | Y | 3 | 1 | Y | Y | Y |
| 138 | Y | 5 | 1 | N | N | N |
| 139 | Y | 10 | 11 | Y | Y | Y |
| 140 | X | 0 | 0 | N | N | N |
| Totals | 126 | 1089 | 1001 | 87 | 86 | 76 |

## Appendix F: Full C2W Codebook

| | |
|---|---|
| Technical Work | Activities associated with engineering design and technical work, including … |
| CAD Modeling | ... modeling something using CAD or learning CAD software |
| Engineering Calculations | … performing engineering calculations |
| Generating/Refining Design Concepts | … creating or developing design concepts or plans |
| Handling Ambiguity/Uncertainty | … uncertainty in the design process itself - e.g. not knowing which design decision to make or which approach to take |
| Problem/Requirement Definition | … defining the design or technical problem itself, understanding requirements or specs |
| Project Budgeting | … developing or sticking to a project budget, cost estimating |
| Prototyping/Testing Designs | … creating prototypes or testing designs |
| Software (non-CAD) | … using or learning software other than CAD |
| Technical Work - Other | … any other technical work not covered by the above codes. Note that this does NOT include their definitions of engineering |
| Tools, Equipment, and Objects | … learning or working with new equipment, tools, or other physical objects (including objects they are designing) |
| Teamwork & Communication | Activities associated with working in teams or communicating clearly, including |
| Client Meetings | … meeting with customers, clients, or other external stakeholders |
| Formal Presentations | … developing or giving a formal presentations |
| Informal Presentations | … developing or giving an informal presentation (e.g. to coworkers or supervisors) |
| Informal Writing | ... writing any type of informal document (memos, emails, etc.) |
| Interpersonal - General | … communicating or interacting with others in the workplace (e.g. colleagues) |
| Interpersonal - Manager | … communicating or interacting with a manager, supervisor, or others higher up in the organization |
| Leadership | ... acting as a leader |
| Project Planning/Logistics | … organizing work among members of a team |
| T & C - Other | … any other aspect of communication and teamwork broadly |
| Team Function | ... discussions of how a team is working |
| Team Meetings | … conducting or participating in a meeting |
| Writing Reports | … writing formal documents such as reports |
| Self-Directed Learning | Activities associated with managing and monitoring one's own time and activities, including … |
| Finding resources | … knowing what resources are needed for a task and/or where to find them |
| Finding work/keeping busy | … finding things to do at work (e.g. during slow times or between projects) |
| Lack of knowledge | ... not having the information, skills, background, etc. to take on a tasks; not knowing enough |
| SDL - Other | … any other aspect associated with trying to manage or monitor work tasks |

| | |
|---|---|
| Time management | … balancing time among different work tasks, dealing with deadlines, or managing the fast pace at work |
| Mindset for grind/routine | … maintaining a commitment to work - e.g. long work days, staying engaged, doing routine or boring tasks |
| Identity Development | Activities associated with seeing oneself as an employee and/or an engineer, including … |
| Role | … knowing what one's role is and/or how one fits into the team or company |
| Competence | … self-evaluation of one's skills, abilities, and knowledge |
| Thinking like an engineer | … knowing how to make engineering decisions or justify ideas |
| Belonging | … feeling connected to or integrated with others at work; sense of belonging; fitting in |
| Identity - Other | … any other challenge associated with how the participant perceives themselves in the work environment |
| Adulting | Activities associated with being an adult in the world rather than a student, being independent, including … |
| Work/Life Balance | Balancing personal and professional aspects of life (e.g. having enough time for personal things, being tired at work because of personal activities |
| Non-work personal tasks | Anything associated with life outside work (buying a car, opening a bank account, relationships, family, etc.) |
| Other Activities | Use this as a code for any relevant not covered in the above categories, but also be thinking about what new codes we might need. |
| Strategies | These codes describe how participants approached challenges or tasks. |
| Finding print/online resources | Locating textual material (books, manuals, web sites, etc.) to better understand the task/situation |
| Training Courses | Participating in training courses |
| Talking to people | Asking others at work for help |
| Working hard | General statements about "doing my best" or "keeping at it" |
| Trying on my own | Statements about just getting in there and trying something |
| Carefulness/attention to detail | Statements about taking extra time, going over work, watching details |
| Planning | Ways of planning or organizing tasks - thinking ahead |
| Strategies - Other | Any other strategies participants use to meet challenges or achieve significant accomplishments. |
| Drawing on other school experiences | Using things learned in school outside of the capstone course |
| Drawing on other experiences | Using things learned outside school |
| Type | |
| Workplace Experience or Event | The participant is describing an event or experience that happened at work, without suggesting that it was a challenge or an accomplishment. |
| Accomplishment | The participant is describing the activity as a significant accomplishment. |
| Challenge | The participant is describing the activity as something they found challenging |
| Strategy | The participant is describing the activity as a strategy they used to |

| | |
|---|---|
| | meet a challenge or succeed at a task |
| Successful Transfer from Capstone | The participant describes the activity in terms that indicate transfer of learning from capstone to the workplace - i.e. the experiences are similar, or the participant used knowledge from capstone in the workplace |
| Difference | The participant describes the activity in terms of a difference between school and work |
| Capstone Advice | The participant is providing advice for the capstone course (e.g., to better align it with work) |