Capstone Design CONFERENCE 2022
JUNE 6–8, 2022 ▸ DALLAS, TEXAS

Implementing Individual Performance Reviews in an Engineering Capstone Design Course

Aaron J. Rubin, Susannah Howe, and Michael Kinsinger
Smith College

Overview: Capstone design projects are typically performed in teams, but measuring individual participation and performance can be challenging. This work-in-progress reviews the process of implementing individual performance reviews in the engineering capstone design course at Smith College in AY2122. Previously, individual accountability had been evaluated through a combination of quarterly peer reviews and end-of-semester logbook entry review. For the AY2122 course, the capstone teaching team piloted performance reviews as a replacement to the logbook review process. The performance review form was informed by examples used in industry by program alumni. Preliminary results suggest that students' individual participation and performance can be evaluated effectively through these performance reviews while also preparing students for a review process that is ubiquitous in professional engineering practice.

Keywords: performance review, assessment, engineering industry, capstone design

Corresponding Author: Aaron J. Rubin, arubin@smith.edu

Background and Motivation

One of the primary goals of capstone design courses is to prepare students for employment after college, helping to ease the transition from undergraduate studies to industry. Many capstone courses, therefore, incorporate various curricular and logistical elements to better simulate industry: industry-sponsored projects, client interactions, design reviews, formal presentations, project management, etc.[1] The literature regarding performance reviews - a standard practice for evaluating employees in industry - in capstone design courses, however, is slim and reflects a range of interpretations. Perhaps the most commonly reported form of capstone performance review is the peer review, where team members evaluate each other and themselves, often several times throughout the course.[2,3] A related practice is the team performance review, where teams evaluate their (individual and collective) effectiveness regarding design process and performance.[4,5] One option for expanding the peer review is to have students meet with the instructor afterwards, identify areas of improvement, and make a list of actions to improve performance.[6] Another reported approach is to use performance reviews as a corrective measure for students at risk of failing.[7]

This extended abstract describes the development and implementation of an industry-informed performance review process in the capstone course ("Design Clinic") at Smith College both to evaluate students and help prepare them for the workplace experience. Design Clinic is a two-semester capstone design experience in which students collaborate in teams of 3-4 on projects sponsored by industry and government. Individual student performance has been evaluated using a combination of quarterly peer reviews, end-of-semester logbook reviews (coupled in some years with an oral interview about the logbook entries), and instructor discretion. Students also participate in an intake interview with the teaching team at the start of the course to set goals and discuss expectations.

In AY2122, the teaching team sought to incorporate an industry-informed performance review process in place of the logbook peer review for two main reasons: (1) to introduce students to the performance review process prior to them entering industry, and (2) to increase student agency and accountability for setting and meeting goals and documenting accomplishments. As such, we needed to develop a performance review form for the students to complete and a process by which the performance reviews would take place.

Development and Implementation of Performance Review Process

Our first step was to establish a baseline of typical industry practices regarding performance reviews. In addition to our own industrial experiences, we solicited input from the Smith College engineering alumni based on the review processes at their organizations. We received roughly a dozen different responses ranging from short descriptions of processes to digital templates used. Although this input came from a wide range of engineering disciplines in both

public and private sectors, the actual content in the performance reviews was generally consistent. Notably, the two common sections of the performance review in the industry examples were Accomplishments (sometimes framed through demonstration of core values) and Goal Setting. These were the core of our performance review.

In creating two forms (one for fall, one for spring) that students would use to document their goals and accomplishments, we wanted to ensure that students understood the duality of the performance review process: simulating industry and evaluating student performance. We thus began our form with the following statement: *The performance review process provides a framework for Design Clinic students' future growth and development. The appraisal process provides a framework for face-to-face discussion between the student and the Design Clinic Teaching Team to more fully understand the student's goals going forward and the individual contributions to date.*

Both fall and spring forms had two main sections. The fall form (see https://bit.ly/PerfRevFall) included accomplishments (3-4 total) and goals (3-4 total looking forward), all of which could be technical, personal, or interpersonal in nature, thus reflecting the wide range of activities that are part of the capstone design experience. The goals section asked students to describe actions to achieve each goal and to describe how success would be measured. The accomplishments section required documentation to support each stated accomplishment. The spring form (see https://bit.ly/PerfRevSpring) combined goals and accomplishments in one section, and added a new section about what skills would transfer to the future.

We introduced the performance review form and process to the class midway through the fall semester. This provided an opportunity to discuss performance reviews in industry, encourage students to use their logbooks (since these could be used as evidence of accomplishments), and promote thinking about professional goal setting. We created a separate Google doc for each student, shared it with the student and the teaching team, and instructed students to fill it out before the end of the semester. We held the performance reviews for the 32 enrolled students over two days during the exam period at the end of each semester in 12-minute blocks; two of the three three teaching team members were present at each review. During the reviews, we asked each student to describe a few of their accomplishments and either listed goals (fall) or transferable skills (spring). We followed up with probing questions about the accomplishments, and we provided feedback on chosen goals or transferable skills. We gave our questions and feedback orally and also as live written comments on the Google doc during the review itself so the students would have access to them.

Assessment of Performance Review Process

We have been pleased by the performance reviews so far and have identified a number of benefits. Although not a stated goal, the performance reviews provide a nice bookend to the one-on-one intake interviews conducted at the beginning of the semester. We found students generally provided thoughtful goals that provided a good framework for a free-flowing discussion during the performance review blocks. The discussion often highlighted accomplishments and clarified goals that were not evident in the written form alone. The length of the review time blocks also seemed appropriate for most students: the blocks allowed for a good discussion, but required very little student time. Moreover, the live comments provided a written record of teaching team feedback and student reflection during the review itself. We also noticed improvement in depth and thoughtfulness of comments in the spring. The discussions were helpful both semesters in grading student performance and in giving insight into which individual performances were driving the project progress.

While many aspects were acceptable or exceeded our expectations, there were some things that did not go as well as hoped. Although we introduced the review process midway through the semester, most students did not start their forms until the end of the semester. Possibly related, we noticed inconsistent buy-in across the class, with 1-2 students filling out the forms at the very last minute both semesters. In addition, students provided varying levels of supplemental documentation and/or did not use the documentation to support their comments in the review form.

Future Work / Conclusion

In general, the initial implementation of performance reviews during AY2122 has been promising. The performance review process has been an improvement over the end-of-semester logbook entry review with a number of positive outcomes. The performance review process gives students a window into the type of experience they will have in the workplace. The process also serves as an opportunity for the capstone teaching team to focus on the goals and growth opportunities of individual students, which can be easily overshadowed by the team-centric nature of the capstone projects. We would also like to improve student engagement throughout the semester. This could possibly be achieved through a tie-in to the intake interviews or setting goals earlier in the semester. We are excited to continue using and improving this performance review process in Design Clinic in the years to come.

References

1. Howe, S., Rosenbauer, L., and Poulos, S. (2017) The 2015 Capstone Design Survey Results: Current Practices and Changes over Time, *IJEE*, 33(5), pp. 1393-1421.
2. Caenepeel, C. and Wyrick, C. (2001) Strategies for Successful Interdisciplinary Projects: A California State Polytechnic University Pomona Perspective, *IJEE*, 17(4 and 5), pp. 391-395.
3. Duncan, G.S., Budnik, M., Will, J., Johnson, P., and Nudehi, S. (2011) Overcoming the Challenges of Implementing Technical Communication in a Capstone Senior Design Course, *ASEE Conference Proceedings*, pp. 22.1135.1-14.
4. Johns-Boast, L. and Flint, S. (2013) Simulating Industry: An Innovative Software Engineering Capstone Design Course, *FIE Conference Proceedings*, 7 pp.
5. Reyer, J., Morris, M., Post, S. L. (2014) Capstone Teams: An Industry Based Model, *IJEE*, 30(8), pp. 31-38.
6. Kremer, G. and Burnette, D. (2008) Using Performance Reviews in Capstone Design Courses for Development and Assessment of Professional Skills, *ASEE Conference Proceedings*, pp 13.1349.1-11.
7. Watkins, G. (2018) Awarding Failing Grades in a Senior Capstone Design Course, *Capstone Design Conference Proceedings*, 4 pp.