AC 2008-2395: SIMULATING CONSULTING ENGINEER RELATIONSHIPS IN A SENIOR DESIGN COURSE AND ASSESSING THE RESULTS

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Simulating Consulting Engineer Relationships in a Senior Design Course and Assessing the Results

Abstract

The civil engineering senior design course at George Mason University and its assessment process underwent some significant changes in the Spring 2007 offering, motivated by a large increase in program enrollment (170 percent over the preceding five years). Some of the methods of course delivery used in prior years do not scale very well to prospective future class sizes of 50 or more. Changes in 2007 included modifying how teams are formed and their specific roles in the project. In particular two teams were designated as engineering consultants who provided services to four other project-based teams. A new two-phase jury evaluation process was also introduced, wherein the jurors had access to a website with the project documents approximately one week prior to the formal project presentations. This was intended to allow a more in-depth evaluation of the technical content of the designs, and a presentation-day evaluation of the team presentation skills. The changes required a revised set of juror evaluation forms, with both repeat of prior content and with sections that were not part of the previous instrument. This paper reports on the assessment results for this revised senior design experience. Two aspects are emphasized: (1) the relative degree of success of the simulated client-consultant relationships; and (2) comparative data for this offering vs. assessment results for the prior three years. Participant views on the new jury evaluation process are also discussed.

Senior Design Course Requirements and Procedures

The details of how the senior design course at George Mason was structured through Spring 2006 were provided in a previous paper (Bronzini and Matusik[1]). To summarize briefly, each student team prepares the preliminary layout and design for a land development project. The lead instructor for the course is a practicing land development engineer, and the support instructors are practicing land development and structural engineers. Local land design practitioners serve as team mentors. Each team takes an assigned actual land parcel in a nearby jurisdiction and, for a specified residential, commercial, or industrial project, prepares preliminary designs for the layout, street system, grading, drainage, water supply and wastewater systems, and all connections to the relevant offsite systems. A portion of the proposed project is selected for a preliminary structural design. The students also prepare a project schedule for their preliminary design effort, develop a construction cost estimate, and perform a traffic impact study. Final projects are presented in a public forum, and various aspects of student performance are graded by a design jury. The land parcel used and the design specifications for each team change with each offering of the course.

As the Spring 2007 semester began the instructors were faced with a course enrollment of 31 students, vs. enrollments of 22 and 18 students the two preceding years. (Enrollment for Spring 2008 stands at 35 students, so the recent growth trend has continued.) In those two prior years the students were divided into three land development teams, which meant teams as large as six to eight students. The experience with the seven and eight person teams was not particularly good, in that it was much more difficult to ensure that all team members contributed substantially and roughly equally to the final products. An obvious solution to this problem is to limit teams to five members, which would have meant having seven teams in 2007 (and again this year). One problem with this is that the annual senior design presentations have become a somewhat institutionalized event for the program students and faculty. An entire afternoon is devoted to this, with strong attendance by seniors and their families, other students, faculty, School administration, and local industry. Three team presentations and an ensuing questioning of the teams by faculty and mentors fit comfortably within this framework, four presentations is a stretch, and five or more would be out of the question. Hence to keep the team sizes reasonable but preserve the single presentation day event and format a new way to form and manage student teams was needed. The solution that was adopted, described next, was designed to both meet the goals established for the presentations and, more importantly, provide opportunities for students to experience some of the business and management challenges of civil engineering practice.

Changes for 2007: Use of Student Consultant Teams

In Spring 2007 the senior design students were divided into four land design teams and two consultant teams. The land design teams proceeded as in past years, with the exception that some of the tasks traditionally done within the teams were assigned to the two consultant teams. One of the latter teams served as the structural engineering consultant. For example, one land design team was assigned to develop a mixed use town center. The structural element called for the design of a pedestrian skywalk bridge between a pair of four story condominium buildings, to connect the similar uses of the two buildings without requiring occupants to exit to ground level. Once the positions and general layouts of the buildings had been selected the structural consultants were able to work fairly independently on the bridge design.

Water resources were the domain of the second consultant team. This consultant performed the pre-build stormwater runoff estimates for the site, which was the same for each of the land design teams. There are obvious economies of scale in this consultant assignment. They also handled the post-buildout runoff calculations, and the design of all required stormwater management facilities.

The two consultant teams were self-selected. Students who had a particular interest in either structural or water resources engineering volunteered to be on the consultant teams. It was the opinion of the course instructors that this team selection method would help to insure that only qualified and motivated students would be on the specialized teams. The land design teams also were given the opportunity to self-organize. The instructors then modified the initial team rosters to correct team size imbalances and to insure that each team had students with strengths in the civil engineering subdisciplines needed for the various projects.

Findings of Previous Research

The method of assigning students to teams described above differs from the careful management of team composition that is used at some other universities (Drnevich and Norris[2], Drnevich[3], Nambisan[4]). There has been virtually no controlled research on the effect of team composition on student learning in undergraduate engineering courses, though Drnevich and Norris[2] do summarize some mixed evidence for teams of MBA students, so it is not clear which team formation methods best support student achievement while also meeting other course objectives and constraints. Most other previous work in evolution and assessment of the capstone (senior) design experience can be categorized into the areas of assessment and the interaction of multi-disciplinary teams.

Many papers have been written on the assessment of senior design in meeting program criteria. In addition to meeting Accreditation Board for Engineering and Technology (ABET) requirements that each program must culminate with a major design experience, the senior design course should demonstrate program outcome achievement, for example in ABET general criteria 3d ("an ability to function on multi-disciplinary teams"); 3g ("an ability to communicate effectively"); and 3h ("the broad education necessary to understand the impact of engineering solutions in a global, economic, and environmental context"), among others. Tooley and Hall[5] give a comprehensive summary of potential outcome achievement from senior design for all outcomes. Shuman, et al.[6] provide an extensive background on the assessment of professional skills outcome achievement. Bronzini and Matusik[1] provide time series data on design jury outcome assessments and show how the results were used to make program and assessment process improvements. Other works consider blended and supplemental criteria for evaluating the effectiveness of senior design (Latcha, et al.[7]; Davis, et al.[8]; Romine, et al[9]). Quadrato and Welch[10] consider criteria for assessing student performance in senior design beginning with the performance standards used and definition of the design problem itself. Chowdhury, et al.[11] report on the use of several assessment tools for a Mechanical Engineering capstone course. These works represent a significant body of knowledge in various programs' experience in assessing the effectiveness of their senior design courses.

Some papers have been published that explore the consultant-client model used in senior design, especially with regard to service learning. Welch and Estes[12] describe the experience of students at the US Military Academy who are given the option to choose community service projects for their senior design experience. The students' interface with community stakeholders was found to engender the client-consultant relationship. A similar service-learning approach is described by Bielefeldt[13] for on-campus clients used in senior design. These works in general describe the experience of students acting as the design consultant to a third party client.

The model of client-consultant interaction solely amongst student peers is relatively new. Chou et al.[14] recently described the use of consultant or sub-contractor design teams. At Minnesota State University, Mankato, the authors have implemented a senior design project where students in other courses serve as subcontractors to the design teams. Students in lower division courses, such as CAD for civil engineering, prepare drawings while students in upper division courses (steel or concrete design) prepare component designs for the overall project. Additionally, faculty and outside practitioners act as consultants to support the primary design and subcontractor teams. The subcontracting model has been implemented over a three-year period and continues to evolve. Initial assessment of this approach, done by survey questionnaires in the final project presentations, has shown mixed success. Respondents reported that increasing involvement across the curriculum was innovative and beneficial, but that insufficient communication in some ways detracted from the experience. Students reported some frustration with the consulting arrangement taking more time than if they completed the component design tasks themselves. Still, the approach fosters rapport development among peers and mimics the interdisciplinary design approach used in the real world.

The approach at George Mason described above differs from prior efforts, in that all of the students involved are in their final semester. However, some of the same types of evaluation data were collected, enabling comparison with these previous research findings.

Evaluation Procedures

Since the department has been tracking juror evaluations of student performance in the senior design course since 2003, using a substantially unchanged evaluation form, there was a strong desire to keep the time series intact by using the same form as had been used in 2006. However, it was recognized that the change in course procedures was significant, and that this presented an opportunity to correct some problems with the prior evaluations[1]. Hence a new form was devised, which retained some of the questions from the prior version, revised others, and added some entirely new questions designed to directly assess the effectiveness of the student consultant team arrangements, and also to directly assess the degree of ABET outcomes attainment. The new form is given in the Appendix; the prior form may be viewed in the paper by Bronzini and Matuski[1]. Qualitative information on the effectiveness of the consultant arrangement was also obtained from students and faculty. Since the new form was longer and asked for more detail the jurors were given access to preliminary student work products and the evaluation form on a website about one week prior to the oral presentations. The hope was that technical evaluations of student work would be based primarily on the website products, and the communication aspects would be judged on the day of the presentations.

Assessment Results

Table 1 presents the quantitative juror assessments over the past four years. In some cases the rating factors used by the jurors in 2007 were different, or were expressed in different words, as compared to the earlier years, so it was necessary to map the new ratings into the old categories. The intent of this analysis was to see if the new course procedures produced any notable or significant changes in juror ratings of student performance. Of course, observed changes could be due to a number of factors, but spotting any changes is the first step in looking for any potential benefits or disbenefits of the new course experience.

As can be seen in Table 1, the results for 2007 track very closely those of the preceding three years. Approximately half of the 23 evaluation scores are higher for 2007 than for 2006, and half are lower. Hence by this measure the new course format had no appreciable effect on the outcomes. Considering the 2007 scores versus the range for the earlier years, new highs were recorded for the following factors (increases 0.05 or greater):

	2007 Score	Previous High
Uses design software tools effectively	4.98	4.71
Team uses graphics effectively	4.65	4.60
Quality of transportation analysis	4.50	4.27
Construction quantity take-off estimates	4.41	4.32

Table 1. Summary of Senior Design Assessment Results

Evaluation Factors	Outcomes	2007 WT AVG.	2006 WT AVG.	2005 WT AVG.	2004 WT AVG.
Oral Presentation					
Team narrative is clear and concise.	g	4.34	4.29	4.11	4.55
Team narrative is comprehensive.	d	4.39	4.49	4.25	4.42
Presenters kept audience's attention.	g	4.38	4.35	4.11	4.63
Presenters were very professional.	f	4.62	4.70	4.59	4.75
Visual Presentation					
Team uses design software tools effectively for supplemental engineering computations.	k	4.98	4.66	4.38	4.71
Team demonstrates competence in the use of AutoCAD.	k	4.65	4.64	4.40	4.47
Team demonstrates competence in the use of Power Point.	g	4.38	4.67	4.49	4.75
Team provides enough detail so that the team solution can be understood.	d, g	4.29	4.30	4.28	4.45
Team uses graphics effectively to highlight correct components of solution.	g	4.65	4.53	4.43	4.60
Transportation					
Quality of transportation analysis of project site.	b, e, h, k	4.5	4.27	3.94	4.12
Use of correct geometry in road/street design.	a, c	4.28	4.40	4.00	4.33
Parking Design	c	4.07	4.09	NA	NA
Environment					
Demonstration of environmental engineering knowledge in the overall site planning	e	4.33	4.30	4.17	4.33
Demonstration of environmental engineering knowledge in specific design components such as storm water drainage; sanitary sewer and water distribution system design and structures	b, c, k	4.29	4.18	4.26	4.28
LID features	h, j	4.2	4.18	4.26	4.28

Measurement Scale: 5 = high, 1 = low.

Table 1. (Continued)

Evaluation Factors	Outcomes	2007 WT AVG.	2006 WT AVG.	2005 WT AVG.	2004 WT AVG.
Structures					
Demonstration of structural engineering knowledge in specific design components	c, e, k	4.54	4.7	3.84	4.55
Construction					
Demonstration of team completing construction quantity "take-off" estimates	c	4.41	4.29	4.32	3.92
Demonstration of adherence to local zoning and building codes	h, i, j	4.42	4.60	3.48	4.42
Social					
Demonstration of knowledge of the specific social and political factors that would affect the project, and development of effective strategies to deal with these factors	h,i, j	3.38	3.87	3.56	3.50
Economic					
Demonstration of knowledge of the specific economic considerations of the project	c	3.69	3.93	3.56	3.91
Team's estimate of the construction costs of the project.	b, c	3.9	4.23	3.74	4.22
Project Management					
Team demonstrated knowledge of Gantt Charts.	d, k	4.41	4.58	3.32	4.40
The project is substantially complete as of the day of the presentation	f	4.62	4.77	4.38	4.88

Measurement Scale: 5 = high, 1 = low.

Likewise, new low scores were recorded for the following factors (decreases 0.05 or greater):

	2007 Score	Previous Low
Competence in the use of PowerPoint	4.38	4.49
Geometric design of roads/streets	4.28	4.33
Consideration of social and political factors	3.38	3.50

None of these changes seem to be related to the simulated consulting engineer relationships. Further, on the specific evaluation factors related to the quality of the structural engineering and stormwater management designs, the 2007 scores are solidly within the range of previous results. It could be argued that the near-perfect score in 2007 for effective use of design software tools is related to the specialized consultant efforts, but it is difficult to conclude that based on a single data point.

Table 2 presents the results in 2007 for juror questions not directly asked in previous years. The first two questions directly address the success of the consulting engineer relationships. Notably slightly less than half of the jurors felt able to evaluate this factor. Those who did respond accorded this factor high marks, approximately 4.45 on a 5-point scale. The 4.62 score for "Team's success in fulfilling client's requirements" might also provide support for the effectiveness of the new teaming approach. The second half of the table records the jurors' direct evaluations of the teams' demonstrations of ABET outcomes 3a to 3k. The scores are quite high, ranging from 4.35 to 4.98, with seven scores exceeding 4.75. Again a near-perfect score of 4.98 was recorded for "ability to use modern engineering tools," essentially replicating the result on use of design software tools seen in Table 1. The 4.79 result for outcome 3d, "ability to function on multidisciplinary teams," seems to support the new teaming concept.

The results of the qualitative assessment were decidedly mixed. The general consensus was that the consulting arrangement worked well in the case of the structural engineering consulting team. The principal reason is that the structural team was able to work quite independently from their client teams from early in the semester, once the basic design controls had been established. The faculty member advising the structural team felt that the quality of the structural engineering work was far higher than what he had seen in prior years. The water resources team, on the other hand, was able to work independently and at-speed only early in the project, for the pre-development runoff estimates. Post-development runoff and design of stormwater management facilities were heavily dependent on the schedules maintained by the client teams. In most cases this meant that the water resources team was left very little time, near the end of the semester, to complete their work. Since that team had virtually no leverage over the client teams this led to significant tension and frustrations, and diminished the quality of the final products. One of the rationales for the new procedures was to enable all of the oral presentations to fit within the available 3-hour time block. This was judged to be marginally successful—the goal was met, but not as well as desired.

Conclusions

The experience with the new senior design format in 2007 was partially successful. The results achieved were similar to what has been observed elsewhere, particularly by Chou, et al.[14] While the teams did gain valuable experience in how consultant relationships work and the importance of cross-team communication, some of the frustrations experienced by the water resources team were judged to be too high of a price to pay for those benefits. The students simply did not have enough project management experience to make the system work effectively. The structural engineering consultant relationship, on the other hand, worked beautifully. The quantitative evidence, while not strong, tends to support the qualitative conclusions.

As a result of the 2007 experience the 2008 version of the course will continue to use a structural engineering consulting team, with the land design teams as their clients. However, no other consulting teams will be used. Other means will be employed to control the format and length of the team presentations.

Table 2. Extract from Senior Design Assessment Results for 2007

Juror Rating (5 = highest)	5	4	3	2	1	Unable to Evaluate	WT AVG.
Project Management	**Number of Juror Entries**						
Interaction of the team with their Structural Consultant	8	10	0	0	0	20	**4.44**
Interaction of the team with their Water Resource Consultant	8	9	0	0	0	21	**4.47**
Team's success in fulfilling cilent's requirements	14	6	1	0	0	17	**4.62**
Team's project tracking and comparison with original plan/schedule	10	4	3	0	0	21	**4.41**
ABET Assessment							
a. ability to apply knowlegde of mathematics, science, and engineering	20	3	0	0	0	15	**4.87**
b. ability to design and conduct experiments, analze and interpret data	18	2	3	0	0	15	**4.65**
c. ability to design a system, component, or process to meet desired needs	22	2	0	0	0	14	**4.92**
d. ability to function on multi-disiplinary teams	21	1	2	0	0	14	**4.79**
e. ability to identify, formulate, and solve engineering problems	22.5	1.5	0	0	0	14	**4.94**
f. understanding of professional and ethical responsibility	17	3	4	0	0	14	**4.54**
g. ability to communicate effectively	19	5	0	0	0	14	**4.79**
h. ability to understand the impact of engineering in a global context	11	5	4	0	0	18	**4.35**
i. recognition of the need for, and ability to engage in life-long learning	14	7	2	0	0	15	**4.52**
j. knowlegde of contemporary issues	18	2	1	0	0	17	**4.81**
k. ability to use modern engineering tools necessary for engineering practice	23.5	0.5	0	0	0	14	**4.98**

The new assessment tool proved to be a big improvement over the prior jury forms. ABET outcome evaluations were much clearer, and both the technical and presentation factors were easier to evaluate. The two-stage jury process worked, and an improved version will be used this year. Hence the evaluation process this year will substantially repeat the 2007 process.

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Bibliography

1. Bronzini, M.S., and Matusik, J. (2007), "Using the Senior Design Jury to Directly Assess Program Outcomes," AC 2007-502, *Proceedings of the 2007 ASEE Annual Conference*, Honolulu, HI.
2. Drnevich, V., and Norris, J. (2007), "Assigning Civil Engineering Students to Capstone Course Teams," AC 2007-939, *Proceedings of the 2007 ASEE Annual Conference*, Honolulu, HI.
3. Drnevich, V. (2001), "Evolution of the CE Capstone Design Course at Purdue," *Proceedings of the ASCE Education Congress*, Houston, TX.
4. Nambisan, S. (2007), "Enhancing the Capstone Design Experience in Civil Engineering," AC 2007-1513, *Proceedings of the 2007 ASEE Annual Conference*, Honolulu, HI.
5. Tooley, M., and Hall, K. (1999), "Using a Capstone Design Course to Facilitate ABET 2000 Program Outcomes," *Proceedings of the 1999 ASEE Annual Conference*, Charlotte, NC.
6. Shuman, L., Besterfield-Sacre, M., and McGourty, J. (2005), "The ABET 'Professional Skills' – Can They Be Taught? Can They Be Assessed?" *ASEE Journal of Engineering Education* **94**:1. pp 41-55
7. Latcha, M., Ganesan, S., Gu, E., and Haskell, R. (2005), "The Melting Pot Approach to Senior Design Part II: Assessment and Improvement," *Proceedings of the ASEE North Central Conference*.
8. Davis, W., Mays, T., and Plemmons, J. (2004), "Rethinking Capstone Courses in Civil Engineering: A Response to ABET 2003-2004 Criteria for Accrediting Engineering Programs," *ASEE Southeast Section Conference*, April 4-6, Auburn Alabama.
9. Romine, P., Gile, W., and Scherf, E. (2007), "Methods for assessing the Impact of a Design Course on Selected Student Traits," AC2007-2895, *Proceedings of the 2007 ASEE Annual Conference*, Honolulu, HI.
10. Quadrato, C., Welch, R. (2003), "Grading Capstone Designs: On Time and On Target," *Proceedings of the 2003 ASEE Annual Conference,* Nashville, TN.
11. Chowdhury, S., Jalloh, A., Rojas-Oviedo, R., Seif, M., and Mobasher, A. (2007), "Capstone Design Course as a Tool for Assessment and Improvement," AC 2007-895, *Proceedings of the 2007 ASEE Annual Conference*, Honolulu, HI.
12. Welch, R., and Estes, A. (2003), "Client-Based Projects for Every Senior – A Mark of Excellence for any Program," *Proceedings of the 2003 ASEE Annual Conference,* Nashville, TN.
13. Bielefeldt, A. (2005), "Challenges and Rewards on On-Campus Projects in Capstone Design", *Proceedings of the 2003 ASEE Annual Conference,* Portland, OR.
14. Chou, K., Wilde, W., and Moaveni, S. (2007), "Subcontracting the Senior Design Project in Civil Engineering" *Journal of Professional Issues in Engineering Education and Practice*, **133**:3.

APPENDIX

SENIOR DESIGN SPRING 2007 JUROR EVALUATION

TEAM ______________________________

GENERAL

Juror Name: ______________________________

Please describe your role as a design Juror. Check all that apply:

__ alumnus __ practitioner __ faculty __ team mentor __ other____________

Did you review the team's designs via the design deliverable website prior to the presentation? ___ Yes ___ No. If yes, please comment on your experience in accessing the design documents: ______________________________

____

ENGINEERING **Please evaluate the Engineering aspects of the team's designs. 5=highly effective/proficient, 1=very ineffective/not proficient**

Site Layout	_____	Comments:	__________
Utilities	_____	Comments:	__________
Grading	_____	Comments:	__________
Easements	_____	Comments:	__________
SWM/BMP	_____	Comments:	__________
Sanitary	_____	Comments:	__________
Water Distribution	_____	Comments:	__________
LID	_____	Comments:	__________
Traffic	_____	Comments:	__________
Parking Design	_____	Comments:	__________
Road Geometry	_____	Comments:	__________
Work Breakdown	_____	Comments:	__________
Cost Estimating	_____	Comments:	__________
Economic Justification	_____	Comments:	__________
Scheduling	_____	Comments:	__________
Structural Design	_____	Comments:	__________
Design Code Compliance	_____	Comments:	__________
Local Code Compliance	_____	Comments:	__________

PROJECT MANAGEMENT

Please evaluate the Project Management aspects of the team's work. 5=highly effective/proficient, 1=very ineffective/not proficient

Interaction of the team with their Structural Consultant : ________

Interaction of the team with their Water Resources Consultant : ________

Team's success in fulfilling client's requirements: ________

Team's project tracking and comparison with original plan/schedule: ________

Comments: ____

SOCIETAL IMPACT

Please evaluate the Societal Impact of the team's work. 5=highly effective/proficient, 1=very ineffective/not proficient

Team consideration of sustainability in design, materials, & methods: __________

Team consideration of historical and cultural impact: __________

Comments: ____

ABET ASSESSMENT

The Accreditation Board of Engineering & Technology (ABET) requires all Engineering programs to assess their achievement with program outcomes. Please rate the degree (5=met, 1=not met) to which this team has achieved the following outcomes.

_____ (a) an ability to apply knowledge of mathematics, science, and engineering

_____ (b) an ability to design and conduct experiments, analyze and interpret data

_____ (c) an ability to design a system, component, or process to meet desired needs

_____ (d) an ability to function on multi-disciplinary teams

_____ (e) an ability to identify, formulate, and solve engineering problems

_____ (f) an understanding of professional and ethical responsibility

_____ (g) an ability to communicate effectively

_____ (h) ability to understand the impact of engineering in a global context

_____ (i) a recognition of the need for, and an ability to engage in life-long learning

_____ (j) a knowledge of contemporary issues

_____ (k) an ability to use modern engineering tools necessary for engineering practice

TEAM PRESENTATION

Please evaluate the quality of the team's presentation. 5=highly effective/proficient, 1=very ineffective/not proficient

Team narrative is clear, concise, and comprehensive: __________

Slides were clear and sufficiently detailed: _________

Comments: ____

INDIVIDUAL ASSESSMENT

Please evaluate the individual performance of each team member. 5=highly effective/proficient, 1=very ineffective/not proficient

Name	Content	Confidence	Clarity	Posture	Other	Comments

STRUCTURAL CONSULTANT

WATER RESOURCES CONSULTANT

OTHER COMMENTS