Senior Design Experience in Electrical and Computer Engineering: Evolution and Lessons Learned

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Background

The Electrical and Computer Engineering (ECE) Department at Kansas State University has developed a Senior Design course over the past five years. It is called ECE 590, Senior Design Experience.

Before the Fall of 2012, ECE 590 was a one-credit course that focused on ethics. Students in their final year were expected to select a technical elective to provide them with a design experience. The ECE faculty decided that a more comprehensive approach was needed to provide students with a more consistent experience. They also wanted a course that more closely aligned with the ABET guidelines for a capstone design course.

For the Fall 2012 and Spring 2013 semesters, Kim Fowler taught ECE 590, Senior Design Experience, as a one-credit course. The curriculum contained most of the same material as taught now. The students were overburdened with work for a one-credit course. The department then moved to a three-credit course in the Fall of 2013.

Between the authors, we have nearly 40 years of industrial experience outside of academia. We designed this course to build on those experiences.

This paper describes ECE 590 and the lessons that we have learned from conducting the course over the four years between the Fall semester of 2013 and the Spring semester of 2017.

Vision, Mission, and Goals

The vision is "Integrity - understanding the big picture." The desire is that students begin to learn the full meaning of integrity and how that definitive concept will guide them in problem solving in their future professional life.

The mission is for students to take the next step toward a professional career. The class strives to help students pull together knowledge and tools from various courses and experiences and model parts of a professional work environment.

There are several goals for the course:

- Bring order to ill-defined problems and recognize the following issues in addressing problems:
    - All problems are ill-defined.
    - Most engineering solutions are suboptimal.
    - All design efforts have ambiguity.
- Understand that communication is integral to all professional endeavors. Consequently, students must:
    - write formal documentation on engineering projects, and
    - give oral presentations to professionals.
- Understand engineering solutions in a broader societal context. Projects and class materials are considered in the context of what happens in the marketplace. The desire is that more than technical solutions are important, hence the study of integrity.
- Describe the qualities of good teamwork. Give students first-hand experience by putting them into project teams and have them work a semester together to develop a product.
- Understand the need for lifelong learning. We provide the students with case studies to then describe tools of lifelong-learning that they would use.

We measure the effectiveness of the class in several ways. One is through feedback of an alumni advisory council. A second way is through industry input. A third way is by measuring how well the students meet ABET outcomes. The fourth way is by surveying recent graduates from ECE graduates of Kansas State University. This paper will focus on the ABET outcomes and the survey results from graduates.

Table 1. Kansas State measures outcomes for ECE 590 with these eight different ABET categories.

ABET letter index	Student Outcomes
(c)	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d)	an ability to function on multidisciplinary teams
(f)	an understanding of professional and ethical responsibility
(g)	an ability to communicate effectively
(g)	an ability to communicate effectively
(h)	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i)	a recognition of the need for, and an ability to engage in life-long learning
(j)	a knowledge of contemporary issues

Course Topics and Materials

The Kansas State University Catalog describes ECE 590, **"**Integrates communications, both verbal and written, with ethics and a collaborative design project to emulate a technical professional environment. Introduces design theory, project management, team dynamics, and socio-economic context to design." The prerequisites for ECE 590 are: Circuit Theory II (ECE 511), Electronics I (ECE 525), Applied Scientific Computing for Engineers (ECE 540), and Written Communications for Engineers (ENGL 415).

Students in ECE 590 are expected to learn and do the following:

- Giving technical presentations
- Engineering ethics with a focus on integrity
- Teamwork
- Communication through writing and speaking
- Pulling together different engineering and design disciplines to develop a product
    - Project management and systems engineering, risk management, scheduling and budgeting
    - Requirements, customers, clients, influencers, and users
    - Analyses – FMECA, FTA, ETA, STPA, Safety Cases
    - Architecture and project design
    - Software
    - Electronics
    - Mechanical enclosures and mechanisms
    - Reviews, test, integration
    - Manufacturing
    - Logistics, inventory, technical support
- Legal aspects of business

Three textbooks used in ECE 590 covered presentations, integrity, and technical development (Harvard Business School Press 2007, Cloud 2006, Fowler and Silver 2014). Throughout the semester students are expected to develop other sources of information for their team projects. Finding and using these other sources of information then folds into the goal of developing tools for lifelong learning.

Presentations

A major component of this class has been the presentations. The students start within the first week of class giving short presentations. The first one is a very short talk on one innovation over the past 200 years. The next week each student gives an elevator speech, in which they greet a potential client, propose a solution for a problem the client has, and asks for an appointment all within less than 30 seconds. Two, successive presentations follow in the next two weeks that are a technical presentation on any selected aspect of an electric vehicle; the main thrust here is to take critique in the first presentation and use it to improve the same talk in the second presentation.

During the technical portion of the semester, the students then pair up or join groups of three. Each pair or team gives a technical case study after lectures from a textbook chapter. These case studies are randomly sorted and assigned at the beginning of the semester. The same pairs or teams finally give a presentation on a legal topic at the end of the semester; again, the legal topic is randomly assigned.

The students also give two design reviews associated with their team projects. In all, students give eight presentations throughout the semester.

Projects

Another main component of this class has been the projects. Each student fills out a short survey of technical and professional interest; the survey has a column of various subspecialties, which the student rank orders; the survey also has a second column of professional markets that they might enter, which they also rank order. After compiling the results, the instructor assigns each student to a team and a project. We feel that assigning projects is important to model a professional environment; occasionally we will accept a student proposal for a project if it is deemed compelling and meets the course objectives.

Projects may be a feasibility whitepaper, a prototype, or an aspect of a design competition. The team develops concepts, which they narrow to one after studying tradeoffs. The selected concept then leads to requirements, further analyses, design description documents, and a user manual.

All teams deliver a Project Plan that they update throughout the semester. Besides the Project Plan, teams designing and building an embedded prototype deliver the following documents: architecture and requirements, report of analyses, concept (or theory) of operations, design description documents, and a user manual. Teams involved in collegiate competitions deliver the documents required by the rules of the competition. Teams preparing a whitepaper only deliver a report on the feasibility and configuration of their subject; sometimes the teams prepare Matlab or Simulink simulations to support their concepts.

Besides the set of documentation, each team gives two design reviews. The first presentation is a Conceptual Design Review (CoDR) given about midway through the semester. The second presentation is a Preliminary Design Review (PDR) given at the end of the semester.

Throughout the semester each team meets at least once a week with the instructor for an update on status. The weekly meetings help keep the students on point, as well as pushes them to prepare their documentation in a timely and complete manner.

The projects are varied as shown in Table 2. The photographs in Figure 1 also display some of the projects and students giving a case study.

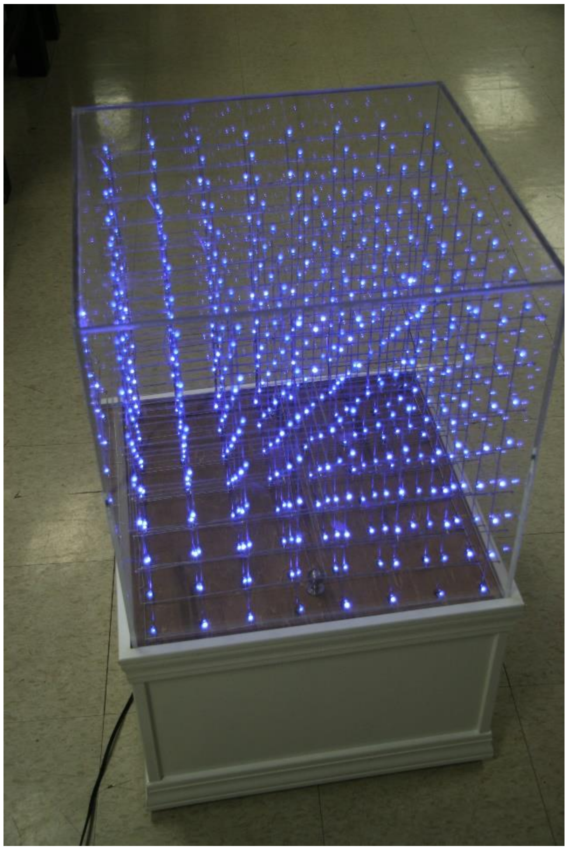
Most projects do not need additional funds; the students present a mock budget and schedule in the design reviews. Some projects are sponsored or financed when hardware is built. To this point, the ECE Department has provided some funds, an NSF grant financed some of the projects for autistic students through Heartspring in Wichita, Kansas, and a biomedical grant supported the PCA Pump Tester. John Deere worked with four students in the Spring 2017 semester to develop a Simulink model that John Deere will incorporate in new product development. We are currently developing new sponsorships for future projects.

Table 2. Projects developed in ECE 590 over the past four years at Kansas State University.

		Project Type		completed
Time	Team	Whitepaper	Embedded Prototype Components	
Fall 2013	1		Wind Turbine Competition	√
	2	Dam Infrastructure Monitoring		√
	3	Kansas Aqueduct: Power Distribution and Security Monitoring		√
	4		Musical Toothbrush (for training autistic children)	
	5	Personal UAV for Tree Canopy Horticulture		√
Spring 2014	1	National Biological and Agricultural Facility/Biosecurity Research Institute (NBAF/BRI) Power Analysis and Design		√
	2	Bus/Tram Power Recharge System		√
	3	Military Autonomous Pack "Mule"		√
	4	Integrated Launch System		√
	5	Inspection Cubesat for other Spacecraft		√
	6		Music Effects Pedal	
	7		Tracking and Musical Toothbrush (for training autistic children)	
	8		Patient-Controlled Analgesia (PCA) Pump Tester	
Fall 2014	1	RPG Defense System		√
	2	Autonomous Silt Dredge		√
	3		Drywall Sander	
	4		Magnetic Compass Calibrator	
	5		Robotic Arm for Inspection Cubesat	√
	6		Patient-Controlled Analgesia (PCA) Pump Tester (continued from previous semester)	
Spring 2015	1		Inverted Pendulum (two-wheeled robot)	
	2		Acoustic Processor Tablet for Demonstrations	
	3		LED Cube (8 x 8 x 8)	√
	4	Autonomous Cargo Port		√
	5	Power for Autonomous Cargo Port		√
	6	Power For Aqueduct from Gulf of Mexico to Western Kansas, Desalination and Pumping		√

Table 2 (continued).

Time	Team	Project Type: Whitepaper	Project Type: Embedded Prototype Components	completed
Fall 2015	1	Local Energy Storage for Wind Turbine Farms		
	2	Hyperloop Design, Kansas City to Denver		
	3		Acoustic Processor on a Tablet for High School Demonstrations (continued)	√
	4		Games for LED Cube	
	5		Heartspring Asset Tracking (tracking autistic children in a facility)	
Spring 2016	1	Moon Base Alpha, Power Feasibility		√
	2	Space Elevator, Power Feasibility		√
	3		LED Reactive Wall	
	4	Smokestack/building Light Show Feasibility		√
	5		Heartspring Asset Tracking (tracking autistic children in a facility, continued)	
	6		Tornado Aerial Chase Vehicle, Instrument Suite	√
Fall 2016	1		KSU Marching Band, LED Plume	
	2		KSU Marching Band, LED Plume control	
	3		KSU Marching Band, audience cellphone app	
	4		Drywall Sander (continued from Fall 2014)	
	5		LED Reactive Wall, installation/software (continued)	
	6		Tracking Toothbrush (for training autistic children, continued from Spring 2014)	
	7	Modular, Portable Power Plant for Disasters		√
Spring 2017	1		KSU Marching Band, LED Plume / control (continued)	
	2		KSU Marching Band, audience phone app (continued)	
	3		LED Reactive Wall, software (continued)	√
	4		Simulink model for John Deere Drive Trains	
	5		Drone with an encircling cage to allow flight indoors	
	6		Autonomous Ledge Cleaner	
	7		Tracking Toothbrush (for training autistic childrent, continued from Fall 2016)	
	8		Galvanic Skin Device (for monitoring autistic children)	√
	9	Matlab Model for Predicting Cost Models in a Microgrid		√
	10	Power and Distribution for Hyperloop between Kansas City and Denver		√
	11	Incinerator Power Plant Feasibility		√
	12	Power Line Deicer		√

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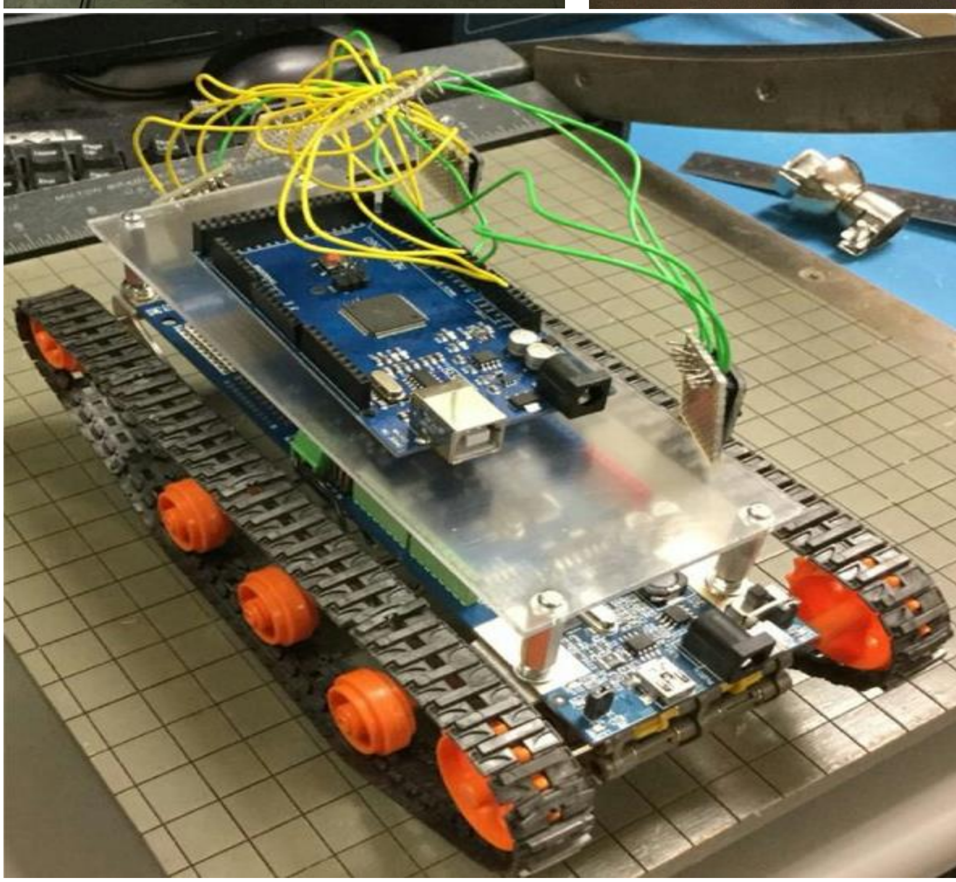

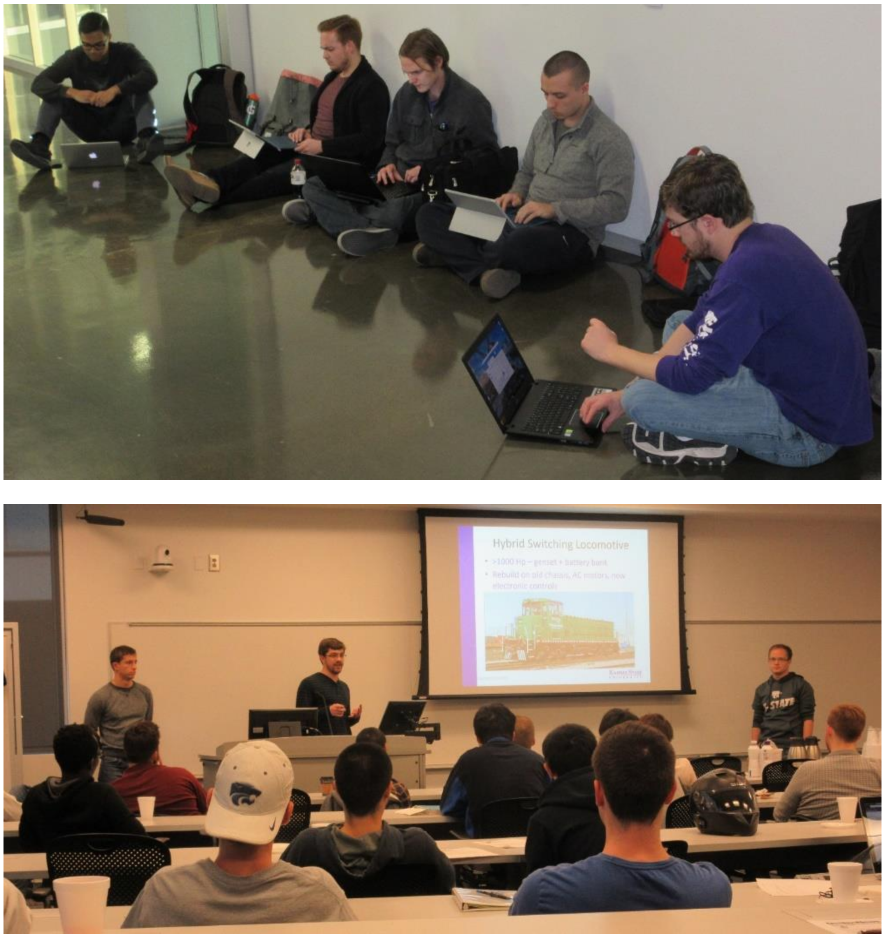

Fig. 1. A few moments captured from ECE 590 – projects, teamwork, and case studies.

Evaluation

Students are evaluated in four different ways. The first way we evaluate students is through testing with 13 quizzes and three examinations, including a comprehensive final examination. The second way is via critique of their presentations (technical talks, case studies, and legal presentations). The third way is through critique of their design reviews, which includes their team documentation. The fourth and final way we evaluate students is through an end-of-semester peer review; each team member anonymously evaluates the other members on his or her team.

Some important aspects of evaluation include timeliness in presentation, eye contact, posture, and gestures during presentations, professional attire during presentation, and peer review. Experience in business has shown that persuasion is a primary factor in technical presentation; these evaluation aspects support a credible and persuasive presentation. The peer review has basis in the 360-professional review that some companies perform with employees. The peer review also gives some insight to the team dynamics that instructors seldom see.

Metrics

While personal experience of the authors is important, the challenge was to find independent means to evaluate the course. We use two different means to evaluate the course: the cumulative scores on ABET indices and an alumni survey.

Metrics – ABET Indices

The cumulative scores based on ABET indices sums the results from 279 students over four years and eight classes, from Fall 2013 to Spring 2017. Tables 3, 4, and 5 give the results of the cumulative scores. The difference in numbers of total students is because we did not include indices c and i before the Spring of 2015. We also did not include the 58 students in Fall 2012-Spring 2013 because that was a one-credit course and it did not include all the elements described in this paper.

We found that students did quite poorly on understanding the need and techniques for life-long learning. We increased the number of examples and case studies for life-long learning in the Fall of 2016 and Spring 2017. Tables 6 and 7 show the remarkable improvements by both sets of students in understanding about life-long learning.

Table 3. Combined scores of all students, both Electrical and Computer Engineering, over four years at Kansas State University.

Letter index	Combined Student Outcomes	E	A	U	Total # students
(c)	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability: semester grade	119	60	0	179
(d)	an ability to function on multidisciplinary teams: grade from team peer review, 15% of semester grade.	252	15	12	279
(f)	an understanding of professional and ethical responsibility: Long Quiz 2 and Exam 1	189	79	11	279
(g)	an ability to communicate effectively: 6 individual oral presentations, Long Quiz 1	252	26	1	279
(g)	an ability to communicate effectively: 2 oral and written design reviews (CoDR and PDR)	227	52	0	279
(h)	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context: Exams 1, 2, and Final Exam grades	141	119	19	279
(i)	a recognition of the need for, and an ability to engage in life-long learning: final exam question	110	17	52	179
(j)	a knowledge of contemporary issues: combination of (f) and (h)	140	125	14	279

Excellent = E, which is ≥ than 85%
Acceptable = A, which is < 85% and ≥ 70%
Unacceptable = U, which is < 70%

Table 4. Cumulate scores of Computer Engineering students over four years.

Letter index	Computer Engineering - Student Outcomes between Fall 2014 and Spring 2017	E	A	U	Total # students
(c)	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability: semester grade	42	11	0	53
(d)	an ability to function on multidisciplinary teams: grade from team peer review, 15% of semester grade.	59	4	1	64
(f)	an understanding of professional and ethical responsibility: Long Quiz 2 and Exam 1	44	20	0	64
(g)	an ability to communicate effectively: 6 individual oral presentations, Long Quiz 1	64	0	0	64
(g)	an ability to communicate effectively: 2 oral and written design reviews (CoDR and PDR)	57	7	0	64
(h)	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context: Exams 1, 2, and Final Exam grades	27	33	4	64
(i)	a recognition of the need for, and an ability to engage in life-long learning: final exam question	29	5	19	53
(j)	a knowledge of contemporary issues: combination of (f) and (h)	27	35	2	64

Excellent = E, which is ≥ than 85%
Acceptable = A, which is < 85% and ≥ 70%
Unacceptable = U, which is < 70%

Table 5. Cumulate scores of Electrical Engineering students over four years.

Letter index	Electrical Engineering - Student Outcomes between Fall 2014 and Spring 2017	E	A	U	Total # students
(c)	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability: semester grade	77	49	0	126
(d)	an ability to function on multidisciplinary teams: grade from team peer review, 15% of semester grade.	129	8	9	146
(f)	an understanding of professional and ethical responsibility: Long Quiz 2 and Exam 1	94	42	10	146
(g)	an ability to communicate effectively: 6 individual oral presentations, Long Quiz 1	126	19	1	146
(g)	an ability to communicate effectively: 2 oral and written design reviews (CoDR and PDR)	127	19	0	146
(h)	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context: Exams 1, 2, and Final Exam grades	61	70	15	146
(i)	a recognition of the need for, and an ability to engage in life-long learning: final exam question	81	12	33	126
(j)	a knowledge of contemporary issues: combination of (f) and (h)	57	77	12	146

Excellent = E, which is ≥ than 85%
Acceptable = A, which is < 85% and ≥ 70%
Unacceptable = U, which is < 70%

Table 6. Improvement in the understanding by Computer Engineers for life-long learning.

Fall 2014 through Spring 2016			Fall 2016 and Spring 2017		
E	A	U	E	A	U
10	4	18	19	1	1
		44%			95%

Percent excellent or acceptable

Table 7. Improvement in the understanding by Electrical Engineers for life-long learning.

Fall 2014 through Spring 2016			Fall 2016 and Spring 2017		
E	A	U	E	A	U
28	9	26	53	3	7
		59%			89%

Percent excellent or acceptable

Metrics – Alumni Survey

We sent a survey to 185 alumni of the program from the Fall of 2012 to the Fall of 2016. These were people who had graduated and entered the work force. We received 43 responses, for a 23.2% response rate. Eight of these were from the first year (Fall 2012 to Spring 2013) when the course was only one credit. We removed these and examined the remaining 35 sets of responses. Of these 35, 40% graduated as Computer Engineers, 20% as Electrical Engineers with a Power focus, and the remaining 20% as Electrical Engineers described as Biomedical, Communications, or other. 21 of the respondents were still in entry-level positions and 14 were in mid-level positions.

Table 8 indicates how much time these alumni spend in communicating and documenting on the job. Communications includes meetings, emailing, presenting, webinars, training, letters, and conversation. Documentation includes reports, technical specifications, manuals, memos, presentations, papers, and white papers. Interestingly, communications and documentation account for over 60% of time in industry.

Table 8. Percentage time spent on communicating and documenting from 35 respondents.

Activity	Maximum (% time spent)	Minimum (% time spent)	Mean (% time spent)	Std. Dev. (% time spent)
Communicating	80	0	34.3	19.8
Documenting	70	0	26.5	19.8

Table 9 indicates how well the course prepared students for giving technical presentations, teamwork, and preparing documentation. The range was from “Not well at all” to “Extremely well.”

Table 9. Adequacy of preparation for communication, teamwork, and documentation from 35 respondents.

Activity	% of Respondents: Extremely, very, or moderately well	Slightly well	Not well at all
Giving technical presentations	71	14	14
Teamwork	69	11	20
Preparing documentation	63	17	20

Finally, we considered individual comments and suggestions written by the respondents. Here are excerpts of some comments and suggestions to improve the course.

- *"Make the projects more 'real world' by having them given by actual companies."*
- *". . . I did not like that the projects weren't real. It is hard to think about . . . design constraints when there is not a solid concept. . . partner with companies so that the end result is something tangible. . . I really hated this class when I was in it, but I now see why it is necessary. I hope you can find a way to get even cocky *******s like me to find Seminar motivating and rewarding"*
- *". . . emphasis needs to be placed on the teamwork/end product instead of the documentation. . . teams must be given relevant projects . . . that can be completed."*
- *"Make ECE 590 into a two semester course. . . One semester feels very rushed and there's only time to brush over most of the topics . . . spend more time on the main group project. . . The tests (midterms and final) were ridiculously long."*
- *". . . the course should be a 2 semester course to allow more time to work on projects."*
- *". . . it does not prepare you for today and how the real business operates today. . . focus on quick, less formal, detailed write-ups in the form of diagrams and written cost/benefits."*
- *"Splitting the course into 2 semesters. . . Juggling a project on top of all the reading and quizzes is completely unrealistic. . . incorporate more of industry type standards and experiences."*
- *"Include units on how to hold an effective meeting."*
- *"The final project was a little over kill. . . my group spent several nights composing all of the required documents."*
- *". . . I conduct research and simulations, write technical publications, and defend my work within the DOD. I took ECE 590 and didn't see the point at the time. However, I can tell you that my ability to write technical documents has been a massively important*

piece of my early success. . . ECE 590 was the most important class that I took to help me learn that skill [being a presenter]."

- *"The 590 class should be completely reorganized. . . have a[n]other professor input [be] a sponsor [to] guid[e] students."*
- *"Focus more on the processes for projects from conception to production like the real world. I suggest pairing with other disciplines."*
- *"In the always-changing technology field, there are much less formal processes of preparing and maintaining documentation. . . [the class should concentrate on] corporate structure (escalation procedures, team dynamics, electronic communication guidelines, intellectual property laws)"*
- *". . . I recommend scrapping ECE590 and its professional development/capstone requirements and turn it into a Systems Engineering class."*
- *". . . the material was relevant. It did teach us quite a bit of stuff about the business of engineering that no other classes touched on."*
- *"Replace with senior level design class."*
- *". . . spent a bit too much time on documentation. I realize today how important it is. . ."*
- *"Have someone with actual experience in industry teach the course so that the expectations are reasonable."*
- *"Cost analysis"*

The comments and suggestions can be summarized into these four primary points:

1. Projects should be cross-disciplinary and sponsored by either businesses or other professors.
2. Require less documentation.
3. Make the course a two-semester sequence that focuses on a project and not on systems engineering.
4. Provide a business focus with cost analysis, processes (like holding meetings), and legal aspects.

We had already reached all these points as conclusions over the past year. While surveys are imperfect, this survey was useful and confirms our direction. We did take the comments with a measure of skepticism, as emphasized by one comment, *"Have someone with actual experience in industry teach the course. . ."* Both authors have direct, applicable industry; Kim has 35 years in designing and managing the development of mission-critical embedded systems and Don has four years in developing spacecraft and space instruments.

We did not include the end-of-semester evaluations for ECE 590. These evaluations were generally given before students had any industry experience or based on very limited internships. Over the years we have received unsolicited comments from alumni who disliked the course but changed their minds after some time in industry.

- One student wrote, "I didn't believe that I would have to do all of the documentation you claimed in [ECE 590] class. As a consultant in the nuclear industry, *documentation is about all I do!"*
- Another student wrote, "*I have to write many documents to keep track of features, code, tests, etc. I believe the work I did in your class is really showing.* I still have a lot of improving I can do, but your class has helped raise my standards for documentation and process."

Lessons Learned

Our experiences in the ECE 590, Senior Design Experience, aligns with reports from other universities (Grabowski, Reilly, and Lawrence-Fowler 2014, Johns-Boast and Flint 2013, Johns-Boast and Patch 2010). The primary lessons that we have learned in ECE 590 over the past five years are covered in the four numbered points above. We agree that the course needs to be a two-semester sequence to give students time to complete projects. We will begin the new format in the Fall semester 2017.We will reduce the course load by removing the systems engineering material and give the students much more time to work on their projects. Within the last year we have begun to incorporate industry sponsors and support from other faculty; the respondents to this survey did not know about these new sponsors, though they probably would approve. Over the past year and a half, we have incorporated legal issues found in business; again, something our survey respondents may not have known. Finally, we are going to emphasize business processes, cost analyses, and problem-solving approaches in the first semester of the sequence beginning this fall.

The statistics that we kept for ABET certification were useful in helping us track how well the course was meeting objectives. The one area that we found where students were not understanding well was in the need and techniques for lifelong learning. In the Fall semester of 2016, we started providing up to four cases studies during a semester to address lifelong learning; the metric we used all four years was the grades for answers to an essay question on the final examination. We found a jump in understanding the issues of lifelong learning from about half of the students to 90% or better.

One area with which we have struggled is gauging how well teams work together. We used an anonymous peer review within each team on the last day of each semester. The problem we encounter was that poorly performing teams could still give each other high marks for teamwork even though their project did badly. Since peer review accounted for 15% of the total grade, people who deserved a lower grade could actually raise their final grade. While the instructor had some discretion to adjust grades, this was difficult to explain to students. In the future, we will index the grades for peer review to the project grade that derives from presentations and completed documentation for the project.

The last area was that some projects would either not complete or change focus by sheer force of personality of the team members. In the future, we will more clearly define the project objectives and require that teams meet them.

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Biographical Information

Mr. Kim Fowler has spent over 30 years in the design, development, and project management of medical, military, and satellite equipment. His interest is the rigorous development of diverse, mission-critical, embedded systems. Kim has worked for several companies designing embedded systems and consulted for both commercial companies and government agencies. He also co-founded Stimsoft, a medical products company, in 1998 and sold it in 2003. Kim is a Fellow of the IEEE and has been both President of the IEEE Instrumentation & Measurement Society for 2010 and 2011 and an adjunct professor for the Johns Hopkins University Engineering Professional Program. He has published widely and has written four textbooks. He has 18 patents - granted, pending, or disclosed. Kim is currently a graduate student in Electrical and Computer Engineering at Kansas State University to obtain his PhD so that he may teach and research on the university level. He has taught ECE 590 for the past five years at Kansas State.

Dr. Don Gruenbacher has served for ten years as the head of Electrical and Computer Engineering at the Kansas State University. Prior to joining K-State in 1997, Gruenbacher was a member of the senior staff in the Space Department of the Johns Hopkins University Applied

Physics Laboratory between 1994-1997 and 1989-1990. He received a bachelor's in electrical engineering in 1989, a master's degree in 1991, and a doctorate in 1994, all from K-State. During his career at K-State, Don has chaired and served on various committees at the department, college, and university level. He has been recognized as an outstanding faculty member by both Eta Kappa Nu and Mortar Board. His research activities are focused in the areas of computer networks, communications, and digital design.