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Engaging Clients in ECE Seminar Course via Clinical Consulting

Dr. Peter Mark Jansson, Bucknell University

Professor Jansson is currently Faculty Director for the Center for Sustainability and the Environment as well as an Associate Professor of Electrical Engineering at Bucknell University where he is responsible for pedagogy and research in the power systems, smart grid and analog systems areas. His specialties include grid interconnection of large scale renewable power systems, Mach Effect detection and smart grid virtual storage via thermal inertia of buildings. He has previously worked for over a decade at Rowan University in their ECE department and in the power and consulting industries for over 3 decades.

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Engaging Clients in an ECE Seminar Course via Clinical Consulting

Peter Mark Jansson, Ph.D.
Bucknell University

Abstract

During Autumn semester 2020 an innovation was trialed in the ECE Seminar course to enable senior ECE students to gain skills in effective consulting by using their own acquired ECE skills to help meet a real-world client's technical needs. This assignment was incorporated into the seminar as either a 20-hour or 40-hour project depending upon how many modules of the course the senior year student was otherwise engaged with. The Action Technologies® workflow model was used assuring the customer's conditions of satisfaction would be met. This novel module allowed students to learn the four key steps of: preparation, negotiation, performance and acceptance. The 14 ECE seniors involved in this pilot chose from nearly 20 available projects and got to decide which projects would best apply their skillsets as electrical or computer engineering majors. Projects ranged from printed circuit board designs for a mission control panel for a local children's museum to developing/running a virtual poster session platform for Bucknell University's annual River Symposium. In each instance, the senior ECE consultant was charged with meeting with their clients to identify their technical needs and then to negotiate a reasonable scope of work (given the 20/40 hour engineering time constraint). After agreeing on project scope they were charged with creating a project plan, list of deliverables/milestones and a Gantt chart schedule. Clients ranged from professors and staff of the university to community partners. It was an important aspect of the project that students would begin to take stock of what their personal engineering skills were and to determine how they could best apply them to help clients better understand their technical needs and jointly develop potential paths forward to satisfy those real-world needs. On a fortnightly basis through the semester, each senior consultant would provide their peers with a brief status update of where they were in the process of developing the solution to the problem/need they were satisfying and how their actual time on each task compared/contrasted with their initial estimates. All seniors were able to see the breadth and depth of their peer's engagement with the consulting opportunities during these sessions and offer input if they had ideas. The majority of the consulting engagements resulted in very successful projects completed within the time constraint and with high satisfaction reported by the clients. The students themselves demonstrated they were capable of accomplishing significant impact in the ½ week or 1 week effort. Their ability to manage such a short term project effectively clearly showed them that their engineering skills can provide high value in serving the world's needs.

Introduction

The ECE department of Bucknell University undertook a comprehensive redesign of its curriculum which was introduced to the EE and CpE Classes of 2021 in their freshman year starting August 2017. In that novel, flexible curriculum students in each major could select from multiple concentration areas to focus a deeper dive into some aspect of the degree that most excited them. In addition, this revision was preparing the department to be in a better position to be responsive to the seven (7) new student outcomes from ABET requirements in Criterion 3[1] which replaced the older eleven (11) a-k outcomes. This change was approved by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology in the autumn of 2017. The new curricula provided multiple touch points for evaluation of student progress against the seven new outcomes. The seminar course actually provides an assessment opportunity for Outcome 3 (an ability to communicate effectively with a range of audiences), Outcome 4 (an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments) and Outcome 7 (an ability to acquire and apply new knowledge as needed, using appropriate learning strategies). The seminar is taught in modules that last a fortnight and the topics are highlighted in Table 1.

Table 1 – ECE Seminar Topics

Career Choice
Standards
Professional Certification
Ethics
Information Literacy
Engineering Economics
Finance
Electronic Components (supply chain)
Self-Marketing
History and Context of Engineering
Entrepreneurship

This seminar is offered in both the junior and senior year (each semester) so that students can have flexibility for when to take it and have an ability to study abroad a semester and still meet their curriculum requirement. While there are other places in the curricula where the three outcomes described above are assessed, it is the design of the ECE seminar to expose the students to many real world skills like those in these outcomes and during the autumn 2020 semester two significant enhancements were made to the course since it would now be having seniors taking it for the second time. The first was the addition of guest alumni speakers, who were charged with helping the ECE instructors to give the course a more “applying these skills after Bucknell focus”. The prompts shared with the guest alumni speakers centered around them addressing any of the course learning outcomes they felt that their professional experience had given them some insight on, and to describe what they do now as professionals after Bucknell and any lessons they have learned on their transition from academic to the working world. Table 2 provides a list of the diversity of their present occupations/employers and graduation years from college. The focus of this paper is to summarize the second enhancement which was to create a new module for seniors who may have already taken

Table 2 – Guest Alumni Lectures Autumn 2020

DATE	COMPANY AFFILIATION	GUEST LECTURER
17-Aug	**NREL (USDOE)**	Jesse Bennett ’15 EE
31-Aug	**US Army Robotics**	Mitch Petrimoulx ’18 CPE
14-Sep	**Horizon Group**	Frank A. Davis ‘82 EE
28-Sep	**Polise Consultants**	Ben Levine ’14 EE
5-Oct	**Capital One**	Zachary Kulis ’98 EE
19-Oct	**SpaceX**	Christina Sfedu ’12 EE

multiple modules being offered in the seminar this semester. Only three of the many modules have a requirement that they be taken twice (Ethics, Standards and Information Literacy). The module was spread out over the entire semester and was entitled: the Senior ECE Clinic Consultant Module. The students were given the opportunity to select available consulting projects from a list of nearly 20 provided or to create their own consulting engagement if they knew of a client in need of their skills. During the piloting of this module all fourteen (14) ECE seniors chose a project from the list in Table 3.

Table 3 – Autumn 2020 ECE Clinic Consulting Project Options

Customer PV System & PP&L data analysis / audit report
Design CAD/packet/circuitry of Mach-Effect detector battery DC motor control system
PCB Design and fabrication for the Lewisburg Children's Museum exhibit
Mission Control panel - for the Lewisburg Children's Museum exhibit
Program to plot output from multiple Raspberry-pi devices in real-time / send to web
Develop/run a “virtual poster session” platform for Bucknell’s 15th River Symposium
Diagnose and repair PV module that appears to be faulty due to a failed by-pass diode
Creating a 3-D version of non-profit logo (files and small product emblems, etc.)
Develop graphical analysis program for pre-post battery tests of MED device
Operate MED device through many trials with data collection & analysis (Some nights)
Diagnose and repair faults on Residential Microgrid and bring to operational status
ECE Consultant support to the Campus Energy Manager
Data acquisition and integration from a remote agricultural field station - BCSE - WSE
Visualization and storage of multiple sources of data from on campus networks - WSE
GIS enabled inventory of campus zero waste management processes
GIS enabled inventory of campus buildings' standby power generation equipment
GIS enabled inventory of BU vehicles; impact of electrifying fleet incl. (V2G) value
Motor temperature and Inertia wheel RPM data acquisition, display and recording
Set up a Software Defined Radio (SDR) to measure signals and develop course projects.

If the student had taken all of the modules being offered in the seminar and would be only participating in the core 3 that had to be taken twice, they would be required to work out a scope of consulting that would take no more or less than 40 hours of engagement. If they were taking most of the modules being

offered in the seminar they would be required to scope their consulting work to 20 hours of engagement. Once students had selected their project they were encouraged to follow the process outlined in the Acton Technologies[2] workflow performance loop shown in Figure 1 (below).

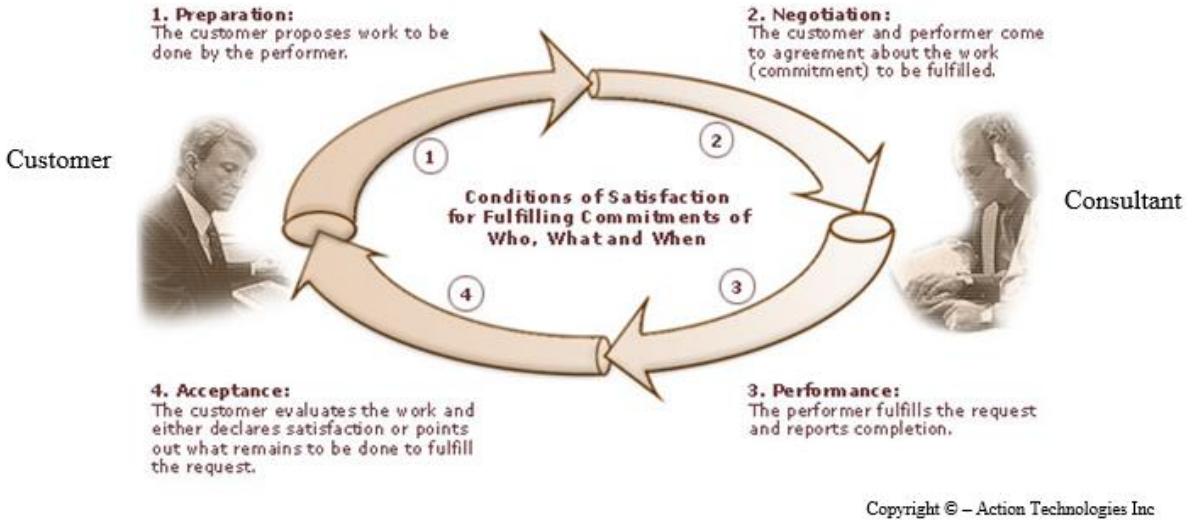


Figure 1 – Closing-the-loop and Meeting Customer's Conditions of Satisfaction

The details of communicating with clients to determine their needs (preparation) and committing mutually to an acceptable scope (negotiation) leads to the performance phase. We discussed in class how to often in the real world of engineering one can find themselves working on either the wrong problem or allowing the scope to go beyond what was agreed upon. The root cause of those problems is often inadequate preparation and negotiation before the work is jumped into. The idea for this course module was based upon an actual course dedicated to ECE consulting that the author had worked on developing at a former university (Rowan University [3,4])

Pedagogy

Since this module involved only about half of the students engaged in the Seminar it was important to cover the materials relating to the consulting module at the end of class so that the juniors who were not involved could depart the classroom or leave the online session to work on other assignments before this module's activities were shared. Each senior was required to present a brief (3-5 minute), informal update on their consulting project with a minimum of three (3) PowerPoint slides addressing their progress/status against milestones with the subset of seniors participating in the is module fortnightly. The assignments included an initial presentation of the project scope, deliverables, and timeline (Gantt chart) for all key project milestones. These regular activities assured that the client needs would be well understood by not only the consultant involved, but all of the seniors participating in the module. They were then able to gauge how well they were progressing compared with their

colleagues. The peer to peer interaction was encouraged and questions and ideas from others were solicited, though there was not as significant engagement by other consultants in one another's projects as was originally hoped for. The details of consulting shared in the module are provided in the appendix.

Results and Client Feedback

As this pilot was the first offering of such a consulting opportunity for the undergraduate engineering students at the university, it was unclear how successful it would be. Given the challenges of engaging students in a small-scale consulting project with a real-world client in the midst of a very busy academic schedule and under COVID restrictions it was an excellent result that most students completed their engagements successfully. Of the fourteen (14) ECE seniors who participated in the module ten (10) fully met or exceeded their client's expectations for the delivery of the final product. That is slightly over 71% of the projects meeting the customer's conditions of satisfaction in this first time pilot (See Fig. 2) The remaining four (4) students made progress toward the client's desired outcomes but were not able to complete them with their 20 (or 40) hour consulting efforts. In addition, four (4) consultants actually exceeded their client's expectations leading to unsolicited comments/praise like the following:

" (the consultant was)… amazing in many ways and was a self starter, didn't need a lot of direction and did more than I asked her to. Very smart and pleasant and professional. Timely, and responsible. A high quality job done by a high quality student." – Campus Energy Manager

" (the consultant)… was outstanding and I would absolutely work with another student in the future! Thanks for the opportunity! The _____ Symposium would not have been as successful as it was without her." – Operations Manager for the Center for Sustainability & the Environment

Consulting Projects Worked on	**Work Met Need?**	**Client Feedback**
Design CAD/packet/circuitry of Mach-Effect detector battery DC motor control system	Exceeded	5.0
PCB Design and fabrication for the Lewisburg Children's Museum exhibit	Major Progress	-
Mission Control panel - for the Lewisburg Children's Museum exhibit	Major Progress	-
Program to plot output from multiple Raspberry-pi devices in real-time / send to web	Met Need	4.6
Develop/run a "virtual poster session" platform for _____ Symposium	Exceeded	5.0
Diagnose and repair PV module that appears to be faulty due to a failed by-pass diode	Met Need	4.4
Creating a 3-D version of non-profit logo (files and small product emblems, etc.)	Met Need	-
Develop graphical analysis program for pre-post battery tests of MED device	Met Need	5.0
Diagnose and repair faults on Residential Microgrid and bring to operational status	Met Need	4.6
ECE Consultant support to the Campus Energy Manager	Exceeded	5.0
Visualization and storage of multiple sources of data from on campus networks	Major Progress	-
GIS enabled inventory of campus buildings' standby power generation equipment	Met Need	-
Motor temperature and Inertia wheel RPM data acquisition, display and recording	Major Progress	3.1
Set up a Software Defined Radio (SDR) to measure signals and develop course projects.	Exceeded	5.0
Average Client Feedback Rating		**4.63**

Figure 2 – Projects, Client Feedback & Work Results

The data provided in column 3 of Figure 2 was created from an analysis of the results of the client feedback survey (provided as Figure 3 below) which was sent to all clients. While we did not hear back from everyone, it was a strong response rate of over 64%. Those project clients not responding are designated by a dashed line in column 3 of Figure 2. Overall, the project clients gave a rating of 4.63 on all responses to the Likert-scaled queries about their consultant's performance. This indicates that they agreed or strongly agreed with nearly all of the positive assessment statements regarding their experience of their consultant's work and value. As shown in Figure 2, column 3 there was only one (1) project where the consulting work was rated below a 4.4, that feedback score of 3.1 clearly indicates that the client was not sufficiently satisfied with the outcomes.

ECEG 310 – Client Survey

During the Fall 2020 semester, you were kind enough to allow one of our Senior ECE students to serve as a consultant to you for a project that you both scoped together. **THANK YOU** for your support of our educational mission at Bucknell University.

The brief survey, which follows, will help us to improve the process in future student & client interactions where meeting the needs of an organization/group like yours can provide a meaningful real-world experience for an ECE student in their final year. If you would please take a few, short minutes to provide the feedback to the questions below it would be much appreciated.

Did the student clearly define for you their time constraint of 20 or 40 hours over the semester?

YES ____ NO _____

Did the student meet with you (virtually or otherwise) to determine a mutually agreed upon scope?

YES ____ NO _____

On the scale below please answer the questions with a 1, 2, 3, 4 or 5

1 – Strongly Disagree 2 – Disagree 3 – Neutral 4 – Agree 5 – Strongly Agree

The student worked diligently to understand the need I had as a client _____

The student communicated with me sufficiently through the semester _____

The effort the student expended to meet my need was sufficient for the task _____

I am satisfied with the result the student achieved on my project _____

The student presented final results to me in a way that was useful to me _____

The outcomes achieved were satisfactory given the time/hour constraint _____

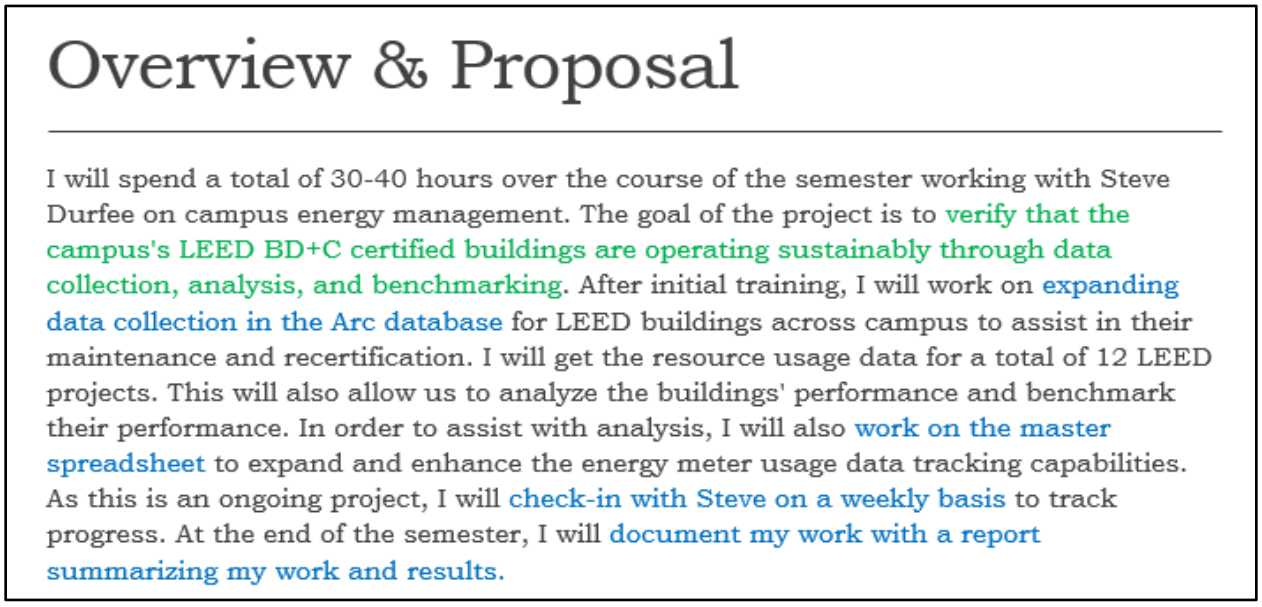
I would consider mentoring an ECE student on similar or different projects in the future* _____

If desired, please provide any comments here on your experience (If you gave less than 4 or 5 to the final asterisked* question – please explain why not):

Figure 3 – Client Survey sent to ALL Clients

Students diligently prepared, submitted and presented their project updates each fortnight with an executive summary for the class. This assured regular project progress throughout the fourteen (14) week semester and gave clear indications of their progress. In the figures which follow excerpts from

early and final presentations are shared so that one can see how student consultants established clear deliverables and scope with their client (Figure 4) and reported regularly on their milestones via their project Gantt charts (Figures 5 and 6). Finally, one of the projects designed, built and tested a control circuit for an empirical experiment regularly conducted by a professor and his student research team, to provide them with battery DC control for DC motors involved in the research experimental protocol (Figure 7). Finally, the online, web-based virtual poster session developed is shown (Figure 8).



Overview & Proposal

I will spend a total of 30-40 hours over the course of the semester working with Steve Durfee on campus energy management. The goal of the project is to verify that the campus's LEED BD+C certified buildings are operating sustainably through data collection, analysis, and benchmarking. After initial training, I will work on expanding data collection in the Arc database for LEED buildings across campus to assist in their maintenance and recertification. I will get the resource usage data for a total of 12 LEED projects. This will also allow us to analyze the buildings' performance and benchmark their performance. In order to assist with analysis, I will also work on the master spreadsheet to expand and enhance the energy meter usage data tracking capabilities. As this is an ongoing project, I will check-in with Steve on a weekly basis to track progress. At the end of the semester, I will document my work with a report summarizing my work and results.

Figure 4 – Scope of Work for ECE Consultant Support to Campus Energy Manager

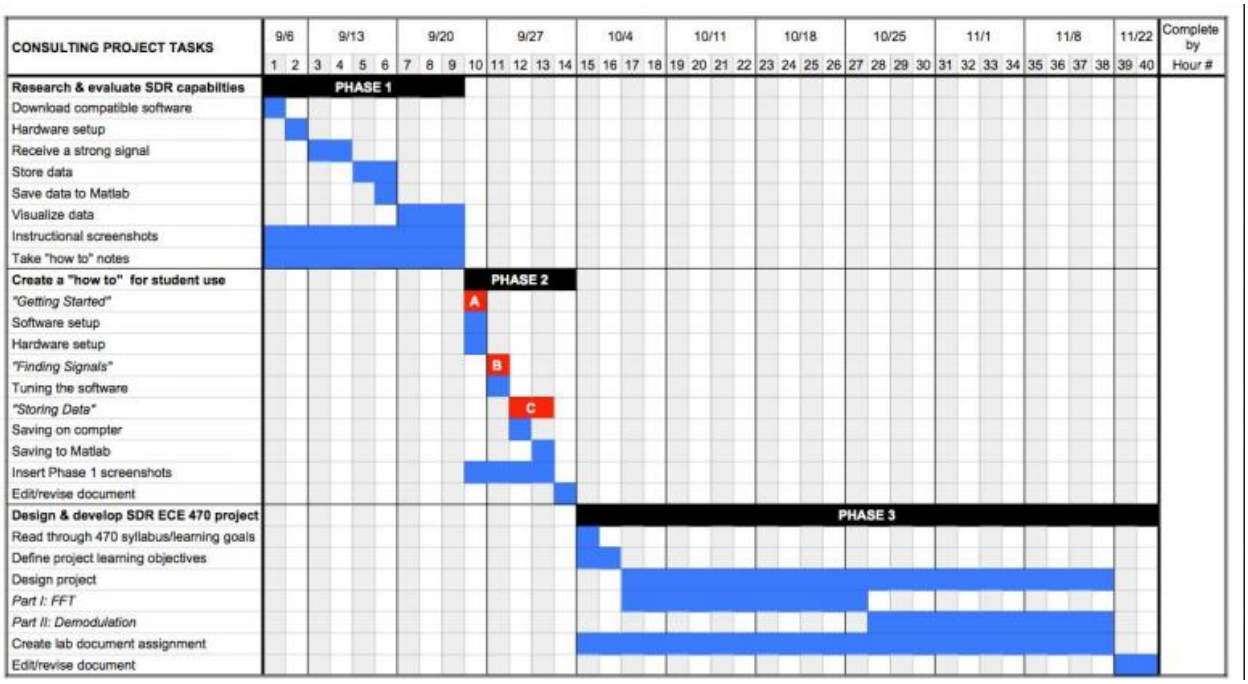


Figure 5 – Gantt Chart/Milestones for Software Defined Radio (SDR) Consulting

15th Annual Virtual River Symposium

Lily Parker | September 21, 2020

	08/30	09/06	09/13	09/20	09/27	10/4	10/11	10/18	10/25	11/01	11/08	11/15	11/22
Define the Problem													
Define the Context													
Determine Solution													
Create WordPress site													
Test WordPress site													
Actual Symposium													
Final Evaluation of Site													

Figure 6 – Gantt Chart/Milestones for Creating Virtual Poster Session for 15th Annual Symposium

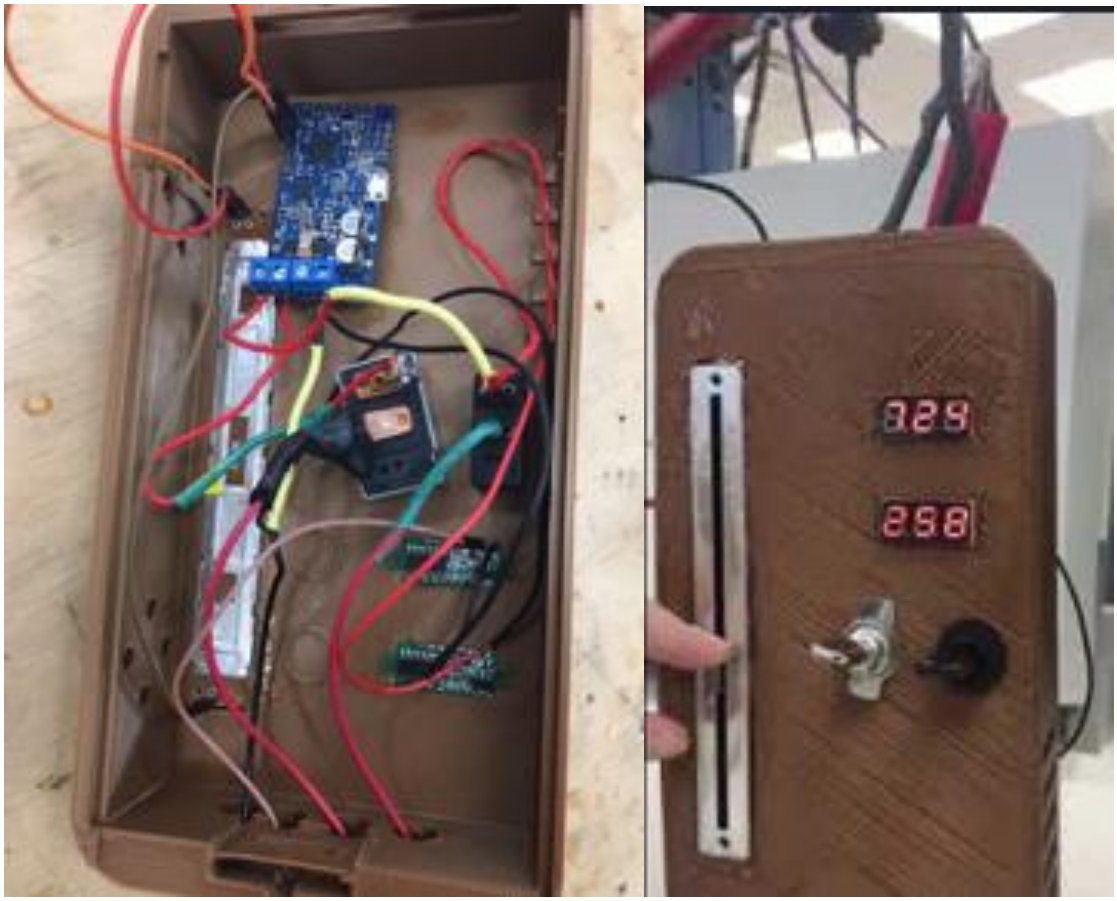


Figure 7 – Designed/CAD/3-D Printed Assembled and Tested DC Controller System

Figure 8 – Online, Web-based, Virtual Poster Session for 15th Annual Symposium

Conclusions

When designing projects to engage clients and to aid students in building confidence in the engineering skills they have developed as educators we often think of capstone design and courses aimed at teaching design through the curriculum. Many of our institutions have such educational opportunities built into our curriculum. This pilot program demonstrated that many important real-world experiences can be learned with much lower stakes projects. In our pilot, while most of these projects were about a forty (40) hour commitment on the part of the student consultant, many (over 1/3rd) were only twenty (20) hour engagements. Even in this short period of hands-on, mind-on application of undergraduate skills, the students were able to gain experience in managing a client relationship, producing a valued and important result for their client while building confidence in their new-found abilities to scope a problem, estimate the labor effort involved in solving it, build a timeline of milestones, track their hours spent on task and reporting in with the class and client as well as a host of other important communication skill intangibles. Further, in this brief module, they got insights and small glimpses into what it is like to be a consultant when you are the only one providing the services to your clients. In a time when so much of our engineering pedagogy revolves around building effective (and very important) team skills, in this pilot we were able to allow all of the senior ECEs in the Seminar to get a brief experience into what many PE consultants, entrepreneurs and start up business owners often do as part of their daily professional lives. It is exciting to report that for the most part all of the students participating in this trial run of engineering clinic consulting in our half-credit Seminar were successful in meeting their client's needs, managing their time and learning more about their strengths as a result.

The department is considering whether or not to add this module to each offering of the ECE Seminar in the future. We will have to keep you posted.

References

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2. R. Medina-Mora, T. Winograd, R. Flores and F. Flores, "The Action Workflow Approach to Workflow Management Technology," CSCW 92 Proceedings – November 1992, online available: https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.151.3701&rep=rep1&type=pdf
3. ECE 09460 - Electrical Engineering Clinic Consultant I, online available: https://www.coursicle.com/rowan/courses/ECE/09460/, last accessed 1 Mar 2021
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Appendix – Example of Consulting Module (Lecture 1 of 4)

ECEG 310: Senior ECE Clinic Consultant Module
Mondays 7.00 PM – 10.00 PM – Gardner Lecture Hall - Room Dana 113
(Weekly Assignments – Lectures/Meetings)
Dr. Peter Mark Jansson, PE

Consulting Lecture 1 – The Skills of the Consummate Consultant (24 Aug 2020)

Learning Objectives:
Understand the skill set of the consummate engineering consultant.
Develop the ability to prepare for offering or responding to requests for professional services

Week	Date	Lecture/ Deliverables/ Reading
2	24 Aug	***Lecture 1:*** The Skills of the Consummate Consultant, action workflow, the types of consultants and consulting engagements, Some key consulting logistics: the scope of work, contract and deliverables.
Next Week Deliverables:		
3	31 Aug	Draft Contract for Semester Engagement review, Scope of Work (Project)

The Skills of the Consummate Consultant

Meet and Exceed Customer Expectations by Clearly Understanding their Needs (Conditions of Satisfaction) and Proposing the Most Efficient and Cost Effective Means to Satisfy their Needs By Using the Skill set Highlighted Below:

Articulate Communication (asking appropriate clarification questions – Listening intently and deliberately to words, their questions, unspoken signals and mannerisms).

Clarity and Criticality of Thinking (think before speaking, try to ask many clarification queries which will help you understand their underlying needs which they may not yet know – why is this important? What do you hope to achieve with this information/product?

Insight into Nature and Source of Problem (what do they think their problem is, how is it manifested, why do they think the solution they are asking for help with is what is needed to cure the underlying cause of the problem?)

Systems / Process Thinking (draw a process map outlining the key areas they have described plus any interfaces with other parts of their organization/system that depend upon the process you have mapped out or feed into the process – show the customer your map ask if it is complete and accurate)

Builder of Long-Term Relationships and Eternal Trust (take time to understand your customer personally, what is at stake for them in this project, what is their highest most desired outcome for this project/engagement, what motivates them and gives them a sense of satisfaction in their work, what shared values do you have, what are their underlying conditions of satisfaction and what would delight them?)

Keen Negotiation (***Always Resulting in a Win / Win***) There is no future in a Win-Lose relationship between consultant and Customer, both parties need to see that each is satisfied and benefitted by the joint work, this is a partnership not servitude, what elements have the most value to the customer and how can you get them to pay for the elements of less value that are needed to assure a successful outcome and accurate, timely and concise deliverable that you both can be proud of.

Delivering by Deadlines (understand their timeframe –do not rush their schedule or delay the provision of the deliverables they are seeking, work fluidly to assure appropriate opportunities for their feedback and input into the process, make time in the schedule to allow that, realize that delivering by deadlines will keep their trust and make future work more likely)

Realistic Estimator and Appropriate Commitments (Do not over-promise, be reasonable about how long things will take, do your estimating and then double – or triple the time to assure you can provide them with a quality product in the promised budget and schedule, make sure each commitment is spelled out succinctly do not leave any ambiguous and open for different interpretation – disappointment can result or you can end up doing significantly more work for little reward)

Project Management (Once you have developed your schedule place all of your required deliverables in a matrix (Hi/Lo on Priority – Hi/Lo on Importance) Schedule your and the team's work based upon the 1-2-3-4 sector priority, develop your project Gantt chart with all deliverables and critical path denoted, share with customer and seek his buy-in and feedback to assure the PM schedule is complete for every element that is part of the deliverables – this removes ambiguity and sources of scope creep and project delays and allows for immediate identification of key elements critical to project success that may have been missed in original proposal or negotiations)

Expert Performance (make sure your team has the expertise to provide the best solution to the problem – in areas where you do not have adequate resources or expertise hire your subcontractors to fill in where needed, the customer does not expect that you personally will have all the skills required for the task only that you have adequate understanding of what the demands of the project are and what skills are needed to satisfy those needs and that you can manage the team to the successful end, do not take short cuts, complete deliberately, expertly and thoroughly all items you have agreed to perform)

Quality Assurance (have others review all your deliverables and reports and especially calculations, make sure there are no errors in any product you give to the consultant, errors lead to a loss of trust in your capability and once lost is quite difficult to recover, when you develop your PM plan and assign responsibilities make sure every item has a QC check by someone not involved in the original calculation, writing or presentation – this goes a very long way in removing embarrassing screamers)

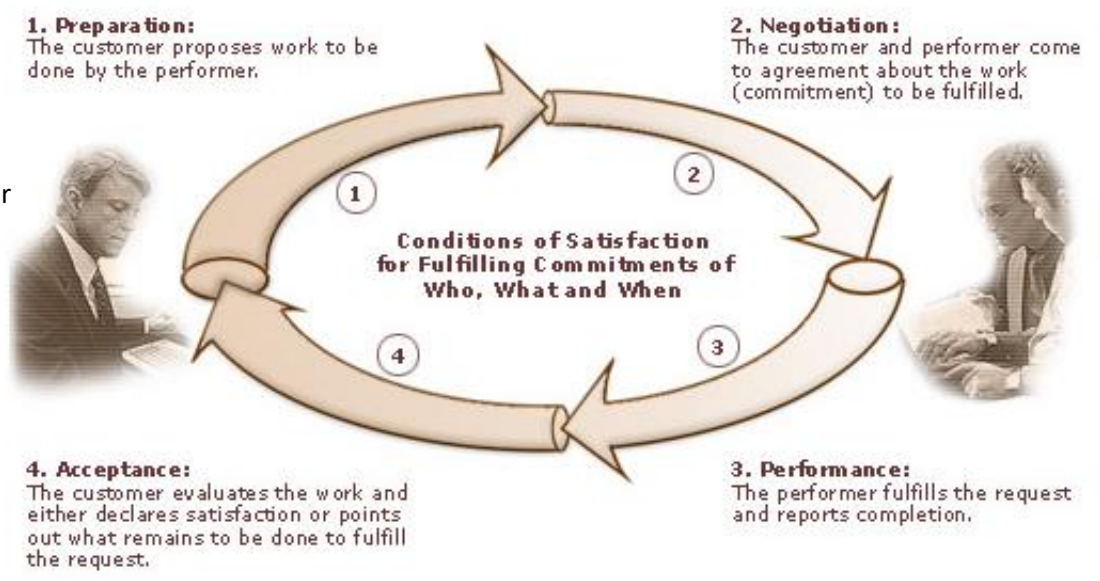
Customer Satisfaction (unfortunately the customer is always right, even when they are really wrong, this adage exists because your firm's reputation hangs on the opinions of your customers, so if they are not satisfied with your work they will not be excellent references and will likely not

be repeat customers, CS is either an ever-increasing positive feedback of your clients building your brand and name recognition or it is whittling away relative to your competitors if you are failing – CS needs to be continually managed in the upward direction to assure your business continues to grow, it only takes a few disgruntled customers (and if savvy they know this) to destroy a business so choose your customers wisely and then work to keep them satisfied with you, if you come across a 'bad' customer do your work well and then move on and do not repeat engagements with them.)

<u>The Art of Successful Consulting Transactions</u>

The Four-Step Process to Fulfill the Conditions of Satisfaction

Customer



Consultant

Consultant is most often in role of Performer – (phases 2 & 3)
This is when Consultant is satisfying a Customer Request (i.e. RFP)

Consultant may also make an Offer when soliciting work for his service and that requires more intimate understanding of Customer Needs to provide a valuable Offer in phase 1 (preparation).

Conditions of Satisfaction must be negotiated in advance of Phase 3 and may require scope modifications.

Assuring satisfaction in Phase 4 is also in the Role of a Consummate Consultant

The Types of Consultants and Consulting Engagements

The most common consultant is the Hired Gun or technical expert brought in for a very specific task requiring very specific skill sets. This represents a large portion of engineering consulting firms in the marketplace: environmental, land development, structural, construction

management. There are also consultants who perform process improvement/assessment, certification (ISO9000, LEED), project management, forensic investigations, expert witnesses, management consulting and a host of other services. Typically, engagements can be as brief as a day or few hours ($1-3k) or long term multi-faceted deliverables taking many months or a few years. In recent time firms have chosen to employ a mix of professional staff some full or part-time employees and some temporary or consultant laborers depending upon the expertise levels required. Depending on your skills, interest and motivation there is almost always someone out there that will pay for you to do piece work for them, so it is up to you as to how ambitious and productive you can be. Typically hourly rates for consulting are in the range of 2.5-3 times the employee's hourly rate in a similar job. Nearly every job, no matter how large or small that can be performed by an employee in an organization is potential consultant work.

The Scope of Work

Brief, concise statement (or paragraphs) of what work is to be performed by the consultant including; complete list of deliverables, key milestones, description of what tasks need to be done (at high level) and any specific details that have been required/requested by the customer as to method, approach, tools etc. that must be utilized. It should be as detailed as required to adequately assure the conditions of satisfaction can be measured objectively and reported on, brevity and specificity are desired attributes of a good scope of work. If scope creep is likely the scope of work can also detail what will not be done and what aspects of the project are beyond the work requested.

The Contract and Deliverables

Always, ALWAYS, ***ALWAYS*** have a contract and/or statement of work agreed upon between you and your customer. While you may think it is desirable to have an open-ended agreement it is a two-edged sword, and can lead to ***ambiguity*** – a most destructive aspect of consulting. The contract or agreement should include at a minimum: the agreed scope of work, the estimated time and cost for the deliverables, the resources that will be brought to bear (employees, equipment, subcontractors) and a brief description of how additional work or scope expansion can be dealt with. It is often desired by the customer to have a fixed price contract or a time and materials (T&M) contract. For fixed price contracts (often required by governmental entities) there will be an estimated cost and a not to exceed cost (which may or may not be the same). For either of these types it is important that the Scope of Work clearly outlines all of the deliverables, so that there can be no misunderstanding of what will be delivered for what price.

When you are writing your proposal for work remember that it often will form the language that will ultimately be in the contract. To view some sample wordings for Scope (see below)