Introduction of Industry-Based Technical Electives within Cal Poly SLO's CM Curriculum

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The California Polytechnic State University, San Luis Obispo requires that all Construction Management majors complete 8 units of technical elective credit as part of the degree requirement. Tech electives are various courses that offer additional information on particular construction-related subjects. This paper will explore the option of adding additional tech elective courses that focus on the various industry sectors within the construction line of work, particularly: residential, commercial, and specialty trades such as MEP. With these areas of construction being the primary job market targets for recent graduates, there is an interest to gain a higher understanding of these industries. With an average of two tech electives offered each quarter and with a curriculum as vigorous and time consuming as Cal Poly's Construction Management program, it can be difficult for students to enroll in tech electives that interest them. With the addition of an industry-based tech elective, it would allow students to attain further knowledge about the area of construction they plan to peruse post-graduation, effectively preparing them more so than the competition. By analysis of surveying, interviewing, and research, this paper will outline a proposal of industry-based technical elective courses to implement within the Cal Poly SLO Construction Management curriculum.

Key Words: Industry Trends, Cal Poly SLO, Construction Management Curriculum, Technical Electives, Education

Introduction

Students who graduate from the Construction Management program at California Polytechnic State University, San Luis Obispo are highly sought after and respected in the professional world. This is due to Cal Poly's outstanding professors as well as to its students for being able to manage such a rigorous course load over the span of a typical four-year degree. Cal Poly does a fantastic job at implementing the "learn-by doing" approach and this is seen very clearly in the Construction Management department. This learn-by-doing mentality inspires students to go fourth and get a first-hand experience of the construction trades. There are many representations of this within construction management, particularly with the various industry-based lab courses such as: residential construction, commercial construction, civil construction, specialties, and industrial. Through these labs, the student is given the knowledge and hands on experience of what an employer would expect from a Cal Poly graduate. However, the learning doesn't stop there. With only a select amount of technical electives offered each quarter, students may be forced into taking an elective that doesn't particularly interest them, which then leads to lack of participation and effort for that course. With the primary areas of construction that students choose to work for post-graduation being residential, commercial, civil, specialties, and industrial construction, it would make sense to allow the student to chose to take a technical elective that would further promote their ability to perform in their given work environment. By allowing students an option to take one of these higher-education industry courses, it would provide a valuable take-away for the student as well as allow Cal Poly to expand its education base of what is offered to be taught within the CM department.

This paper is purposed to explore the student satisfaction rates of our currently offered technical electives and to explore the possibility of offering a new technical elective based on what the students would like to gain further knowledge on, their future job. With Cal Poly requiring 8 units of technical elective credit, there should be an additional option to gain a technical skill relative to the area of construction of interest to a student. "Technical" is defined as, "having special and usually practical knowledge especially of a mechanical or scientific subject; marked by or characteristic of specialization," per the Merriam-Webster dictionary. With a course having an emphasis on an industry-based area (ie. residential construction), it lets the student gain a higher understanding and develop a technical skillset about that area, and that is essentially what a "technical" elective is.

Current Construction Management Curriculums

The information gathered examines the construction management programs of various colleges within California as well as out of state. By examining these select programs, it allows us to see which schools offer a more specialized education into the various construction sectors as opposed to a generalized oversight. This will allow us to better understand why these colleges have certain curriculum structure they do and how it benefits the student during their undergrad as well as post graduation. To gain a better understanding of how the structure of each college is organized, we will take a look at each school's Construction Management curriculum and flowchart, particularly looking at specialized, industry-based courses. The colleges analyzed are: *California Polytechnic State University, San Luis Obispo, Chico State, Fresno State, as well as Louisiana State University*.

California Polytechnic State University, SLO: The current curriculum for 2015-2017 requires that all CM majors have 189 units of credit to graduate, 8 of these units are tech elective courses with units ranging from 1-4; each student potentially can take 4 tech elective courses. These tech electives vary from a broad range of subjects and just to name a few there are: BIM, landscape architecture, contracting license preparation, as well as more. Exploring a bit more into these tech electives we see:

- Introduces various areas of the construction trades through lab classes such as: residential, commercial, civil, industrial, specialties, etc.
- The technical electives noted on the Cal Poly Flowchart and on PASS do not always correlate.
    - The flowchart shows there are these tech electives offered: CM 420, CM 421, CM 422, CM 423, CM 424, CM 425, and CM 426. *
    - PASS shows there are on average two (2) courses offered. This quarter in particular, Fall '17, offered CM 422, Professional Preparation, and CM 421, Emerging Trends.
- The tech electives offered vary from quarter to quarter. Some of these listed above (*) are not offered anymore while others are only offered while studying abroad.

Chico State: The flowchart for the 2014-2015 school year (most recently updated on the Chico State website) shows a variety of courses pertaining to Business, Math & Science, as well as Construction. The construction courses offered mimic those of Cal Poly's to a lesser degree.

- Multiple courses are "building blocks" on each other, ie.: Business law, Legal Aspects of Construction, Construction Contracts; Construction Method Analysis, Construction Estimating, Construction Cost Management.

There seems to be a repetitive aspect in the curriculum. There are fewer courses, with similarly-related topics for the courses that are offered.

Fresno State: Fresno State's CM program requires its students to take three tech elective. These tech electives fit into three categories: construction tech electives, construction design electives, and Construction Sector electives.

- The Construction Sector electives have information pertaining to the various areas of construction similar to Cal Poly's curriculum:
    - CM 150, Building Construction (CM 214, Residential / CM 313, Commercial)
    - CM 151, Heavy Civil (CM 314, Heavy Civil)
    - CM 166, Mechanical Systems II (CM 411, Specialties)

Louisiana State University: LSU has the best of these four colleges' example of an industry-based curriculum. Within their four-year Construction Management program and along with the GE construction courses, the students choose one of six paths relative to construction, noted as "Industry Emphasis Areas (IAE)". These paths are and consist of:

- Industrial: Industrial Estimating, Industrial Project Controls, Industrial Construction Enterprise, and Industrial Electrical Installations
- Commercial: Commercial Estimating, and Commercial Construction Enterprise, and choose 3 electives: Internship, Sustainable Construction, Communication and Leadership in Teams, and Building Information Modeling
- Highway: Highway Construction, Highway Construction Enterprise, and choose 3 electives: Internship, Driven Pile Construction, Sustainable Construction, Principles of Highway Traffic Engineering, Geometric Design of Highways and Airports
- Residential: Residential Descriptions and Code Specs, Residential Development, Residential Construction Enterprise, and choose 3 electives: Internship, Real Estate Finance, Small business Management, and Human Resource Management
- Military (ROTC Only): Choose 3: Adaptive Tactical Leadership, Leadership in Changing Environment, Developing Adaptive Leaders, Leadership in a Complex World
- General: Select 4 of any IAE electives above or: Hazards, Disasters, and the Environment, or Fundamentals of Emergency Management

This curriculum in place allows for the student to engage with the area of his/her particular interest. It heightens the student's ability to perform due to the flexibility of courses and direction one can take.

Methodology

The methodology that comprised this paper is primarily quantitative data gathered from a survey sent out to the Cal Poly CM student body, as well as from information gathered on various universities having construction management programs and research comparing and contrasting their construction education curriculums. The survey sent out contained eight questions pertaining to Cal Poly's current tech electives offered for construction management majors. With 31 responses, or a response rate of about 30% of all current CM students, the results seemed to be just shy of a concrete analysis of the CM student population. The survey was intended to see how students are benefiting from the current tech electives offered through Cal Poly as well as to see what students thought was missing from the CM program. Primarily, the survey was oriented to decipher if our current tech electives in place are helping the students with their career path choice in the long run.

Survey

This survey highlighted the current tech electives offered, which industry of construction interests each student the most, as well as if the students see a need for additional tech electives more pertinent to their post-grad plans as opposed to the current electives in place now. Some questions had very one-sided responses, favoring the likelihood of enrolling in a new elective. Students were asked to comment and voice their opinion on our current tech electives as well as what they would like to see offered in the coming years.

- Many stressed "not enough options or variety," "the electives we want to take, aren't offered the quarter we need them," or "not anything in my area of focus"
- Mentions of the need for specific skills necessary for the trade they wish to enter post-graduation
- Very prominent acknowledgement of the need for new electives

Through the results of the survey alone, it was clear that the tech electives currently offered do not suffice for many of the CM students.

Interview

An interview from a recent Cal Poly SLO CM Alumni, Marlo Castro, was conducted over the phone on November 20, 2017. Marlo graduated in June 2017 and now works full-time for DPR Construction as a Project Engineer in the Bay Area, CA. She believes that the courses offered during her undergrad were beneficial and prepared her well for the working world, however, she did note that she had wished the order of which the courses were to be taken had been changed to follow along concurrently with select lab courses. "I believe it would be extremely beneficial to

have supplemental tech elective courses that could be taken alongside CM labs…it would enhance learning and improve retention of the information….," said Marlo. With the current tech electives in place refraining from tying directly to any specific industry, the introduction of a new tech elective purposed for this exact reason would "surely benefit the student when later applying the same principles to the jobsite (Marlo)." By having an industry-based technical elective, it would not only help gain and retain more information, it would begin to peak their enthusiasm for entering the working world. When Marlo was asked to complete the same survey as requested of the current Cal Poly CM student body, her answers and comments mimicked those of the students' (see *Results and Analysis* for data). It was clear that by offering a tech elective relative to the specific industries it would be beneficial for the student and give him/her an upper edge prior to obtaining a full-time position.

Results and Analysis

The information gathered has been collected from a survey was sent out to the entire current CM student body, roughly 100 students, and 31 students responded and completed it as well as from an interview from a recent Cal Poly CM graduate. This survey was opened on October 31st, 2017 and the last response was received November 6th, 2017. The survey contained eight questions with both multiple choice and short answer responses. These questions can be found in Appendix A. Based on the survey's results, 74% of the students who took the survey were upper classmen (junior, senior, super seniors) which is useful in determining a more clearly defined stance on this topic due to having taken more classes than the freshman and sophomores. Out of the students who participated in the survey, 84% had answered Yes to having an interest in a specific area of construction that they wished Cal Poly had touched more on. Of those students who answered yes, the next question asked which area of construction would this be, commercial construction being the primary answer (See Figure 1). One student specified Other and wrote in Estimating as his primary interest in construction; this response was omitted due to the nature of it being an outlier as well as already included in various construction courses such as: CM 214, CM 313, CM 314, CM 280, along with more.

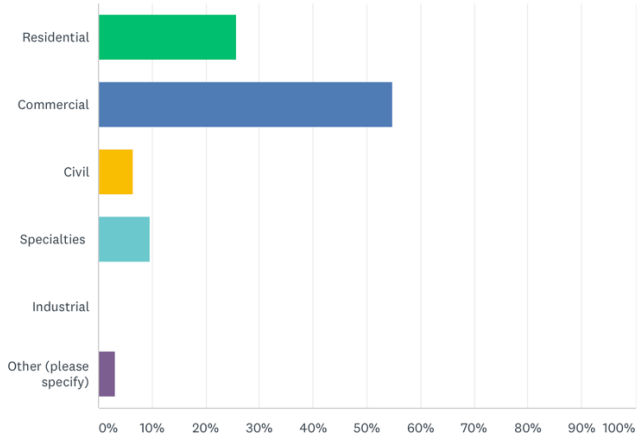


Figure 1: Cal Poly CM student's primary areas of interest within construction.

Since all students choose to take various tech electives and each student's needs are different pertaining to what their future holds, Cal Poly can give each student a kick start in their career by listening to what the students want and implementing an industry-based tech elective course. It would not impact the construction program as a whole, merely benefit the students with an area od their interest which promotes the betterment of their future. When asked whether the students would like to learn more about their industry of choice via a new tech elective apart from what Cal Poly currently offers, 94% answered Yes. Based on the same premise, 87% answered Yes to Cal Poly needing additional alternatives to the current tech electives offered. Although this survey only represents roughly 1/3 of the CM student body, the results are in favor of seeing a change toward a more industry-applicable tech elective (see Figure 2).

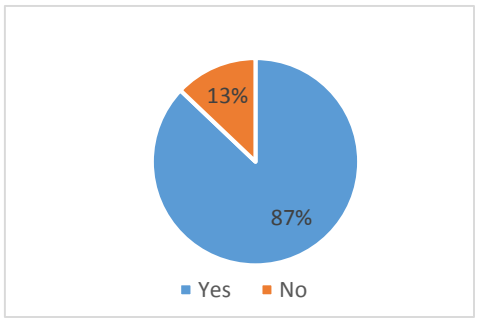


Figure 2: Student response for whether CM needs additional tech elective course options.

The most desired industry area lies with commercial construction. Based on student poll results, there is a strong interest in taking a tech elective based on the principles first introduced in CM 313, Commercial Construction Lab, as well as within the residential and specialty construction labs. Through the collected poll results, nearly half of students that participated are not satisfied with the current tech elective courses offered, an astonishing statistic (see Figure 3).

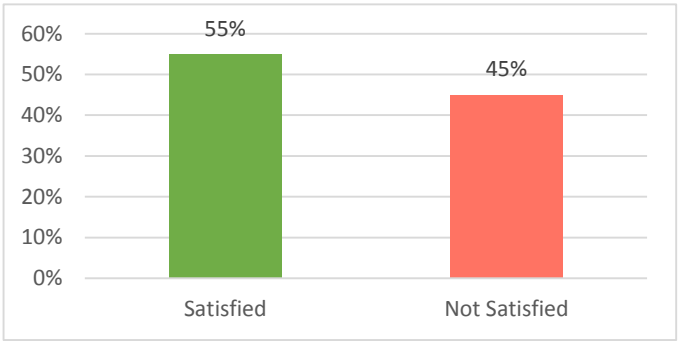


Figure 3: Student satisfaction of currently offered technical electives.

It is clear that there is need for new courses to be offered that encase the desired 'technical' aspects of the construction industry. These

Proposal for an Industry-Based Technical Elective

In accordance to the survey conducted, 84% of current Cal Poly construction management majors indicated that they wish that Cal Poly touched more on a specific area of construction and 87% opted YES for wanting additional tech electives to be offered. With the top three areas of interest being 1st - commercial, 2nd - residential, and 3rd - specialty trades such as MEP, there is definitely a strong desire within the CM student body for additional knowledge on these areas. This notion is backed by a 100% YES rate for wanting to learn more about these specific industries. The findings from the survey show that 93% of CM students would like the option to take a 1-2 unit tech elective relative to the industry of interest to them, the top three areas of interest being commercial, residential, and specialty trades respectively.

At this time, there are is a bit of freedom when choosing which tech electives to take. Given that each student needs typically four tech electives (averaging 2 units per tech elective), the introduction of a new tech elective(s): residential elective, commercial elective, and specialties elective, will allow the student to further peruse his/her passion in the construction industry[1]. This paper proposes a new tech elective course that will be required, yet still gives the student the freedom to choose which one of the three primary industry electives to take. The proposed courses would be available to be taken at a set quarter each year, for example: Residential tech elective would be

[1] Assuming the top three industries sought after are Residential, Commercial, and Specialties based on *Figure 1*.

offered each Fall quarter, Commercial tech elective would be offered in Winter, and Specialties tech elective would be offered in Spring. With each quarter offering a specific industry tech elective, it allows students to better plan their courses through graduation.

Proposed Course(s) Structure

A generalized look at what the new industry-based technical electives will offer during a regular 10-week quarter at Cal Poly: *Residential Technical Elective*. The class will be scenario and team-collaboration based. The class will be split into teams consisting of clients, contractors, and architects which would allow each team member to interact at varying stages of construction, as it would be with a full-time position within a construction company. This course structure would best represent the Learn-by-Doing approach that Cal Poly thrives on. (Course material subject to change for each industry).

- Week 1: Introduction and re-cap of CM 214 Residential Lab
- Week 2: Meet the Team
- Week 3: Site Planning and Development
- Week 4: Material Procurement and Begin Phase 1
- Week 5: OAC Meeting and Schedule/Budget Alignment
- Week 6: Energy Efficiency and Change Orders
- Week 7: Curveball
- Week 8: Completion of Construction and Turnover
- Week 9: Analysis and Prepare Final Presentation
- Week 10: Final Presentation

A scenario-based residential elective allows the students to think how to solve various situations that may occur during select construction phases. The professor will give an overview and provide industry knowledge and insight to the topics at hand each week. This sets up the students to go fourth and face their scenario with facts and use real-world applications. For a student whose passion is to go into residential development, this proposed technical elective would better prepare them for what they plan to do post-graduation.

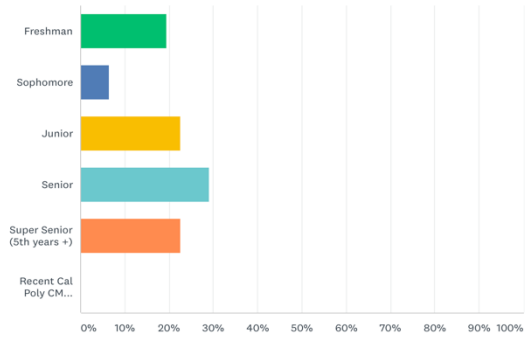
Conclusion

It is important to keep in mind what the students want to see change as well as what is feasible for the school and beneficial in the longevity of the student's career. With only a small pool of tech elective courses available to take each quarter, it hinders the student's ability to choose a course they are interested in, so they settle for "what works with their schedule" rather than "how can I make the most of my college education". With the introduction of a specific industry-based tech elective offered each quarter, it would allow students to plan ahead and pursue an elective that would both work with their schedule as well as better prepare them for post-grad work plans. The addition of an industry-based technical elective would better prepare the student for post-grad work plans as well as promote and maintain recognition of the Cal Poly SLO CM program as being one of the best in the nation.

Appendix A

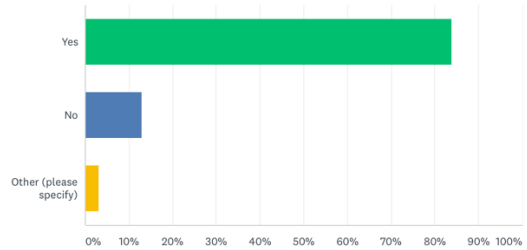
What year are you in?

Answered: 31 Skipped: 0



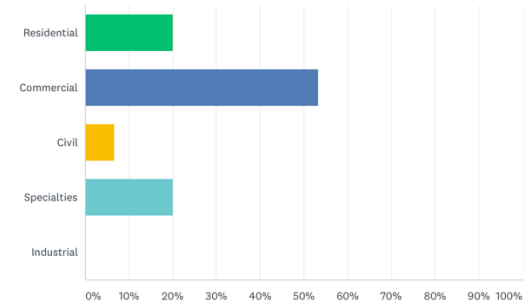
Do you have interests in a specific area of construction (residential, commercial, civil, specialties, industrial, etc.) that you wish CM touched more on during your undergrad?

Answered: 31 Skipped: 0



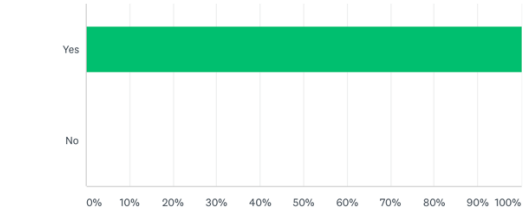
If you answered Yes to the previous question, which area of construction would you want a "tag-along" course to provide more indepth information?

Answered: 30 Skipped: 1



Would you like the option to learn more about this industry? (based on the previous question)

Answered: 31 Skipped: 0



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