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Associated Schools of Construction Student Competition: Team Preparation and Benefits to the Careers of Participants Now Employed in the Construction Industry

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The Associated Schools of Construction (ASC) is currently sponsoring student competitions in all seven United States regions, as well as the International Region. These competitions, which began in the 1980's, allow student teams to compete in a variety of categories and provide a valuable applied form of learning for students in construction-related academic programs, as documented in prior research by others. These student events have become very competitive and teams seeking to become successful typically invest an extensive amount of time and effort to prepare for the competition. This paper examines student competitions in general and specifically one university's efforts to prepare undergraduate student teams for the ASC competition. Also, graduates who participated on a team within the past 14 years were surveyed about the perceived benefits of the competition to their construction careers. The survey instrument also incorporated many of the new 20 student learning outcomes (SLOs) as required by the American Council for Construction Education (ACCE), with the idea of measuring the benefits of the competition relative to these SLOs. The results of the survey provide a general interest topic for industry professionals, faculty members and team coaches.

Keywords: ASC Competition, Student Learning Outcomes, ACCE

Introduction

Student competitions in engineering and engineering-related disciplines, such as construction, have existed for many years. These competitions vary in nature, are sponsored by a variety of professional organizations and allow students to work on a team in a collaborative manner to solve a problem. Examples include aeronautics design (Society of Aeronautical Engineers), human powered vehicles (American Society of Mechanical Engineers), concrete canoes (American Society of Civil Engineers) and mechanical design and construction (Mechanical Contractors of America). The Associated Schools of Construction competition is a relative newcomer to the arena of student competitions and based on the increasing numbers of student participants this competition is playing an increasing role in construction education.

Literature Review and Background

A number of studies have been conducted pertaining to team preparation and the reason behind student success in these competitions (Wankat, 2005). Some general studies have also been conducted about the benefit of the competitions from a student's perspective, as well as the general value to construction education (Bolivar & Holt, 2014). Other studies have recognized student-perceived benefits from observations and surveys (Schuster, Davol & Mello, 2006).

Studies specific to the ASC competitions have also been conducted. Anglin and Robson (1999) conducted a survey of 40 students and coaches from seven schools and 25 industry members at the ASC Region 7 competition in attempt to measure the educational value of the competition. Based on their research, Anglin and Robson conclude that academic competitions should be considered as "meaningful educational experiences for all competitors and potentially all students in the programs". Several studies have measured the perceived increase in skill levels among students participating in the ASC competitions. In one particular study, 40 students, all from one construction management program, who participated in the Region 6 and 7 ASC competition, were surveyed prior to and after the competition in an attempt to measure the students' expectations as well as their perceived benefits of participating in the competition. Questions were asked in six skill areas (quantity takeoff, scheduling, etc.). The results of the questionnaire indicate a perceived increase in skills among the students of 10.9%. The authors of this study conclude that "the competition survey showed that students' self-perceived skill levels were higher in all areas, suggesting that their participation in the event increased their self-confidence." (Bolivar & Holt, 2014).

The afore-mentioned studies were based on either surveys of faculty coaches and industry members or surveys of students currently participating in the competition. The research in this paper takes a different approach, as it focuses on the perceived value of the competition from the view of alumni who are currently growing their careers within the construction industry.

Skills required during the ASC competition include both hard skills (HS) and soft skills (SS). Studies have shown that hard skills in the construction workplace are specialized technical business skills necessary to manage construction projects at all levels. These technical skills include data analysis, math, construction means and methods, estimating, scheduling and technology-related applications for the management of construction projects (Laker & Powell, 2011; Sirotiak & Walters, 2009; Robles, 2012). Hard skills are tangible skills many construction professionals utilize on a daily basis, but studies have shown soft skills, in combination with hard skills are also necessary for construction professionals (Mahasneh & Thabet, 2015). More recently, studies have been conducted that explain or define the soft skills construction professionals utilize each day. These studies show soft skills commonly found in the construction profession include interpersonal or non-technical skills such as communication, leadership, professionalism, stress management, social intelligence, planning and organizing, work place productivity, critical thinking and problem solving, self-confidence and emotional intelligence (Laker & Powell, 2011; Mahasneh & Thabet, 2015; Sirotiak & Walters, 2009).

ASC Competitions

The ASC student competitions began on the west coast in the 1980's with Regions 6 and 7. Currently all seven United States-based regions and the International Region 8 host student competitions in a number of categories. Each category offers a real-life problem sponsored by a construction or construction-related company and typically consists of an actual project that is either complete or in progress. Regional competition divisions are detailed below in Table 1. All ASC member schools are welcome to participate in the open division problems, while competition in the other divisions is limited to schools within the particular region (ASC website, 2016).

Table 1

ASC Regions and Competitions

ASC Region	Competition Divisions	Competition Dates
1	Commercial, Heavy/Civil, Design-Build	November
2	Commercial, Heavy/Civil, Design-Build plus Open Categories	October
3	Commercial, Heavy/Civil, Design-Build, plus Open Categories	October
4	Commercial, Heavy Highway, Design-Build, Specialty, Residential (cancelled in 2015)	October
5	Commercial, Heavy/Civil, Design-Build, International Design-Build	February/March
6	Commercial, Heavy/Civil, Design-Build, Mixed-Use and nine Open Division Categories	February (combined with Region 7)
7	Commercial, Heavy/Civil, Design-Build, Mixed-Use and nine Open Division Categories	February (combined with Region 6)
8	International Region, competition began in 2014 and the category varies	November

Central Washington University (CWU) consistently participates in the Region 7 competition in the three categories of Commercial, Heavy/Civil and Mixed-Use (formerly Multi-Family and Residential). At one point in time the program competed in the Leadership in Energy & Environmental Design (LEED). The Region 6 and Region 7 competitions are completely separate but are held concurrently in Sparks, Nevada, a suburb of Reno, in mid-February. The number of teams competing in each division varies from year to year but typically ranges from eight to 15 teams. These competitions have been growing over the years and currently host over 1000 students from schools ranging from Alaska to New Mexico.

The problem types, content and deliverables for these two regions vary annually between categories. A typical real-life problem consists of a project selected by the category's industry sponsor and the industry sponsor provides the judges for their problem. The competition is held over a three-day period; Thursday, Friday and Saturday. Early Thursday morning the six-member team obtains the problem from the judges and works on the written portion of the problem from early morning until late evening. Deliverables typically include equipment selection, estimates, bids, schedules, site layout plans, subcontractor selection and answers to plan reading questions. A 30 to 45 minute oral presentation and question and answer session takes place the following day in front of a panel of judges who were typically involved with the actual project. A problem recap by the judges, who then explain how they actually built the project, takes place after all teams have completed their oral presentations. Winners are announced on Saturday morning, with awards given to the top three teams in each category. Judging is based on the teams' written deliverables as well as their presentations.

Team Selection and Competition Preparation

Since the Region 7 competition is held in mid-February Central Washington University (CWU) selects the teams near the midpoint of spring quarter during the prior year. Students submit a resume and cover letter to detail their qualifications and their team preference. Since the Construction Management program is relatively small, graduating about 35 students per year, CWU typically sends only three six-member teams. Consequently, most of the students who apply for a team are selected. The selection process is performed by the three faculty members

who coach the three teams. Every effort is made to place each student on the team of their choice and typically each team consists of six seniors with a junior in the program serving as the team alternate.

Teams prepare for the competition throughout fall and early winter quarter. The preparation has been formalized by creating three separate one credit (on the quarter system) 400 level classes, one for each team. Each student participant must enroll in the class and each class is taught by a separate construction management faculty member who serves as the team coach. Each team selects an industry coach or coaches, who help throughout the preparation process and may attend the competition to watch the teams during their presentation and identify areas of improvement to help next year's teams. As part of the one credit course each team meets with their faculty coach at least once per week. During the first part of fall quarter teams may be given smaller projects, or portions of larger projects, on which to work. A typical project is a 40,000 square foot local grocery store, for the commercial or mixed-use team, and a two-lane bridge project for the heavy/civil team. Deliverables include preparation of an estimate and bid, a site layout plan, a schedule, answers to plan reading questions and an oral team presentation to the faculty coaches. These smaller projects are developed by the faculty with some help from industry partners.

As the quarter progresses each team typically takes on more responsibility, which includes more detailed written work and oral team presentations. At the end of fall quarter and then in early January, as the competition approaches, teams will tackle one, two or even sometimes three full-scale projects under circumstances that emulate the actual competition. These projects vary in nature and scope by competition category but are much larger than the earlier problems. Typical dollar values range from $20 to $60 million and the projects are often very complex. The teams meet early in the morning, are provided the same computers and supplies that they will be taking to the competition and work throughout the day and evening. The problems are selected and organized by the industry coaches, who also serve as judges as the teams present their practice problem under the same format as they will encounter in the competition. This practice becomes a very valuable learning experience, as the industry coaches provide immediate feedback to the teams so that they can make adjustments prior to the competition. This format also allows the students to build a fairly close relationship with industry professionals. The students appreciate the fact that the industry coaches are willing to share their time and experience and the industry professionals always mention that they benefit from the students' enthusiasm and desire to succeed at the competition.

Seeking funding to attend the competition has typically been the joint responsibility of the faculty, student competitors and university. The student teams create a budget and write letters to a select group of industry supporters who have been identified as expressing an interest in the competition or have been donors in past years. Total expenses for each team are typically $5,500 to $6,000, which includes the cost of air fare, rental of a university van, lodging, team shirts and about $100 reimbursement for meals for each student. Usually three students choose to drive in a university van to transport computers and team supplies. In past years the fundraising efforts have met the needs for all three teams.

American Council for Construction Education (ACCE) Student Learning Outcomes (SLOs)

All construction management programs accredited under the American Council for Construction Education (ACCE) must assess their programs using an outcomes-based approach utilizing 20 student learning outcomes (SLOs). Each SLO is evaluated based on a minimum of two assessment methods, at least one of which must be a direct assessment showing evidence of student learning in the form of a student product or performance that can be evaluated. A second method of evaluation for each SLO is through an indirect assessment, which must be evidence of student learning where the learning is a perception, opinion, or attitude of the student or others. Table 2 below shows each of the twenty SLOs and their definitions (ACCE, 2016):

Table 2

ACCE Student Learning Outcomes (SLOs)

SLO #	Student Learning Outcome
1.	Create written communications appropriate to the construction discipline.
2.	Create oral presentations appropriate to the construction discipline.
3.	Create a construction project safety plan.
4.	Create construction project cost estimates.
5.	Create construction project schedules.
6.	Analyze professional decisions based on ethical principles.
7.	Analyze construction documents for planning and management of construction processes.
8.	Analyze methods, materials, and equipment used to construct projects.
9.	Apply construction management skills as a member of a multi-disciplinary team.
10.	Apply electronic-based technology to manage the construction process.
11.	Apply basic surveying techniques for construction layout and control.
12.	Understand different methods of project delivery and the roles and responsibilities of all constituencies involved in the design and construction process.
13.	Understand construction risk management.
14.	Understand construction accounting and cost control.
15.	Understand construction quality assurance and control.
16.	Understand construction project control processes.
17.	Understand the legal implications of contract, common, and regulatory law to manage a construction project.
18.	Understand the basic principles of sustainable construction.
19.	Understand the basic principles of structural behavior.
20.	Understand the basic principles of mechanical, electrical and piping systems.

Research Methodology

The methodology for this mixed-method research focused on the perceived benefits of the ASC Competition experience to graduates employed in the construction industry, utilizing both quantitative and qualitative data (Creswell, 2003). The research also tied the perceived benefits to the ACCE SLOs that are relevant to the competition. To measure the perceived benefits to the careers of construction management graduates who participated in an ASC competition a list of approximately 170 student participants who graduated over the past 14 years was created. This list included both the year in which each student graduated as well as the team on which they participated (Heavy/Civil, Commercial, Mixed-Use, LEED).

A survey of 19 questions to measure the benefits of the competition to the careers of these graduates was created. The 19 questions are closely tied to the Construction Management program outcomes and where chosen to measure both hard and soft construction skills. Many of the hard skills that relate to the ACCE SLOs include scheduling, plan reading/contract documents, utilization of construction technology, estimating, site layout and utilization, written communication, construction means and methods, project delivery, and managing construction project risk. Soft skills measured in the survey include benefits that can enhance a graduate's career, such as oral communication, leadership and self-confidence. In addition, the questions were created to include 13 of the 20 ACCE SLOs. Each response to the questions in this survey was tracked using a Likert scale, with a response of "5" being Strongly Agree and "1" being Strongly Disagree. Each student's year of graduation and the team on which they participated

was also tracked in an attempt to measure benefits to their careers as a function of the type of work they perform, as well as the length of time since graduation. The survey and results are presented below in Figure 1 and Table 3. Note that the ACCE SLOs corresponding to the question are provided in the tables but were not shown on the actual survey instrument. In addition to the Likert scale questions, a qualitative component to the survey was included to allow the participants to provide comments on how the ASC competition affected their careers.

Results

Both qualitative and quantitative data was collected from the participants in the survey. There were 56 survey participants, resulting in a 33% response rate from 170 surveys. The survey was distributed by the alumni office using an email registry with email addresses collected from the alumni office database. The researchers were only interested in past students who had participated on either the Mixed-Use, Commercial, Heavy/Civil or LEED teams. In some cases graduates may have participated two years in a row. The results identify that the alumni who participated in the survey graduated between the years of 2001 to 2015. Figure 1 below shows the groupings of the survey participants and their respective teams.

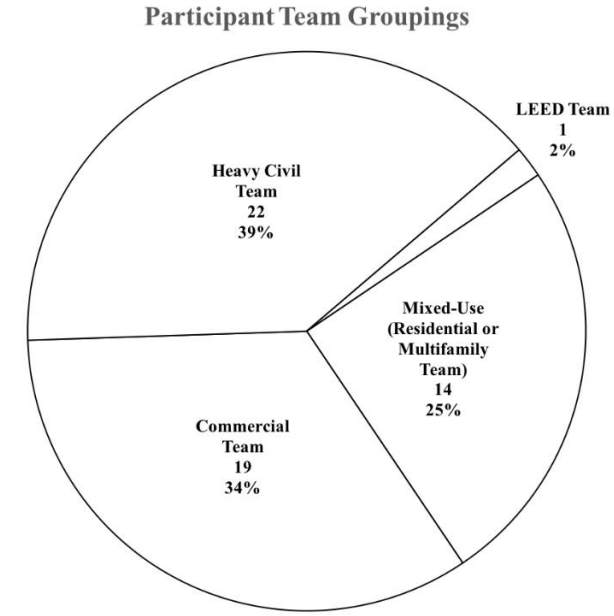

Figure 1: Participant Team Groupings

Generally, CWU's Construction Management program only sends three teams to the competition. Occasionally an additional team was added (LEED) based on the numbers of students applying to participate in the competition, number of faculty resources available to coach the teams or student interest in a particular competition category. The perceived benefits of the ASC competition were all very positive for every item in the survey, with the means ranging from $M = 3.55$ to $M = 4.61$. Of the 19 items in the survey instrument four items provided results that identify the perceived soft skill benefits and the rest of the fifteen items targeted the perceived hard skill benefits, as shown in Table 3.

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Table 3
Results of Perceived Benefits of ASC Competition

Question	ACCE SLO number	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean
1. The competition assisted me in securing an internship or permanent position		15	16	13	9	3	3.55
2. The competition enhanced my plan reading skills (HS)	7	16	36	3	0	1	4.18
3. The competition enhanced my scheduling skills (HS)	5	16	31	8	0	1	4.09
4. The competition enhanced my understanding of contract documents (HS)	7	15	34	4	1	1	4.09
5. The competition enhanced my understanding of specialty contracting (HS)	20	4	28	21	2	1	3.57
6. The competition enhanced my understanding of cost estimating (HS)	4	23	27	5	0	1	4.27
7. The competition enhanced my understanding of bid preparation and submittal (HS)	4	33	19	3	0	1	4.48
8. The competition enhanced my understanding of site layout and utilization (HS)		21	26	7	1	1	4.16
9. The competition enhanced my written communication skills (HS)	1	12	33	9	1	1	3.96
10. The competition enhanced my oral communication and presentation skills (SS)	2	38	16	1	0	1	4.61
11. The competition enhanced my understanding of how to make decisions based on ethical principles (SS)	6	7	25	22	2	0	3.66
12. The competition enhanced my understanding of how to analyze construction methods, materials and equipment (HS)	8	17	27	11	0	1	4.05
13. The competition enhanced my understanding of how to apply electronic-based technology to a construction project (HS)	10	9	24	17	5	1	3.63

14. The competition enhanced my understanding of project delivery systems and roles and responsibilities of those involved in the construction process (HS)	12	14	30	11	0	1	4.00
15. The competition enhanced my understanding of how to manage project risks (HS)	13	12	31	11	1	1	3.93
16. The competition enhanced my understanding of safety applications on a construction project (HS)	3	6	27	19	4	0	3.63
17. The competition enhanced my ability to work as a team member (SS)		34	21	0	0	1	4.55
18. The competition enhanced my leadership skills (SS)		33	21	1	0	1	4.52
19. The competition improved my self-confidence (SS)		30	23	2	0	1	4.45

Note: N = 56

The results of this study indicate the greatest perceived benefit of the competition to the careers of construction management graduates is enhanced oral communication and presentation skills (M = 4.61). In fact, four of the top five benefits are related to soft skills, including working as a team member (M = 4.55), leadership skills (M = 4.52) and improvement of self-confidence (M = 4.45). The related SLOs that were found to be a benefit to the student participants' careers include oral communication and presentation skills (M = 4.61), bid preparation and submittal (M = 4.48) and understanding cost estimating (M = 4.27) as shown in Table 3 above.

When correlating results with the ACCE SLOs, the SLOs with results greater than 4.0 (M > 4.0) are tied to hard skills utilized in construction. These include understanding of bid preparation and submittal, plan reading, reading contract documents, scheduling, analysis on the utilization of construction means, methods, material and equipment and project delivery systems and roles and responsibilities of those involved in the construction process.

Qualitative data was also collected for this study to identify the participants' "personal experience" relative to the perceived benefits of the ASC competition (Creswell, 1998). Out of the 56 survey participants, 32 (57%) participants provided qualitative data suggesting that the competition was the "best real world learning opportunity provided to students in construction management." The participants also commented on the fact that the competition "greatly improved my confidence and understanding of what it takes to work as a team and what it takes to put together a project proposal." Other common themes that were expressed through the open-ended question included key words such as value, preparation, stress, personal strengths, working under pressure, strict deadlines, urgency, eye opening and real-life experience.

Conclusions and Future Work

This study identifies many career benefits to alumni who participate in the ASC competition and also identifies the benefits of the competition as they correlate to the ACCE SLOs. Graduates' response to the survey indicate anecdotally that these benefits include enhanced communication and presentation skills, teamwork, leadership, preparation and submittal of bids, self-confidence and cost estimating. The results of the study also show that 60% (12 of 20) SLOs can be identified and tested as a result of participating in the ASC competition.

Valuable future research in this area of inquiry could involve tracking a sample of students from the time they start their college career at a particular university and asking similar questions before the students enter the competition and then again after the competition, as a pre-test and post-test. Further studies would use the same students and track them as they progress in their careers, and then correlate this information to the ACCE SLOs and to the results of the students' performance on the American Institute of Construction (AIC) exam.

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