

Review of Online Construction Programs

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This research presents a review of existing online construction management and construction engineering management undergraduate and graduate programs. While demand for online programs is growing across numerous disciplines in the United States, limited aggregate data exists cataloging online degree programs available in construction. For this study, researchers performed a manual online search to identify existing programs. Program information was documented, analyzed and compared. Metrics included cost, credit requirements, length of program and prerequisites to coarsely characterize differences from a student standpoint. Accreditation for each program was also noted. Findings generally reveal a relative homogeneity within undergraduate programs and graduate programs, with the largest category of online programs being construction management graduate programs. The primary contribution of the research is to benchmark existing online construction programs to inform educators of available opportunities as well as to characterize similarities and differences. Furthermore, the outcome of this research may motivate additional online construction education program development.

Key Words: On-line Education, Construction Education, Assessment, Pedagogy

Introduction

Today, students, industry and academia alike seek new and innovative delivery methods for construction education. Such demand is partly driven by a significant shortage of skilled workforce in construction, and partly driven by a rapidly changing technology landscape and transformed construction business practices (McGraw-Hill Construction 2012). Over the past 20 years, online education has become more popular in higher education throughout the United States and most higher education institutions regard this content delivery method as critical for the future success for higher academia (Allen & Seaman, 2014). Nevertheless, challenges exist. Bourne, Harris and Mayadas (2005) noted that development is slow for online engineering education programs, and Ibrahim and Morsi (2005) documented the academic challenge of balancing engineering experimental and applied experience with online education programs. In general, limited research exists comparing online versus traditional delivery of various engineering content, and, in particular research is limited that assesses the impact of traditional and online learning on faculty-student interactions in construction education (Mason et al., 2013; Valdes-Vasquez and Clevenger 2015). One barrier to construction and engineering education is that online education is typically characterized as isolated, impersonal and self-paced (Bourne, Harris, & Mayadas, 2005). While grades of the students have been shown to be equivalent between in-class and online courses, the students enrolled in an online course are more likely to not complete the courses (Griffith et al. 2014; Jaggars and Bailey 2010; Jaggars et al. 2013). According to Ali, Hodson-Carlton, and Ryan (2004), the students' relationship with online instructors was no different than in face-to-face courses. However, online students sometimes feel they cannot get the same time and support from their instructors compared to students in the face-to-face courses. In these situations, teacher participation in online discussions, using students' names in communication, and providing timely feedback on assignments can have a positive impact on student and teacher's connection (Dixson, 2010; Hughes, 2007).

Several studies have been conducted to identify the effectiveness of online and computer-based training modules in engineering education. Just-In-Time Assessment and Review (JITAR) mathematical online modules were developed to identify the effectiveness of learning different levels of mathematical abilities, from basic knowledge to more advanced skills. Research showed positive improvements for students when they had access to online review materials as compared to previous semesters without review materials (Ozturk et al. 2015). Another study exploring online learning investigated the impact of course design on learning outcomes. Two versions of an online course

were analyzed, one version used formative assessment to provide student feedback during the learning process while the other version used summative assessment. This study showed that the participants of the course that used formative assessment learned more, and had more positive attitudes towards the content of the course and their future learning (Lawton et al. 2012). In addition, Vanderbilt, Northwestern, Texas, Harvard, and MIT (VaNTH) developed challenged-based instructional modules to identify the effectiveness and reliability of improving performance of students in a variety of educational settings and student populations. Additional research studies focused on identifying challenges for incorporating new knowledge areas and skills into existing curriculums and programs. These studies focused on technology innovation in the architecture, engineering, and construction (AEC) industry, and included the recent trends for university curricula (Becerik-Gerber, Gerber, and Ku 2011); engineering and Building Information Modeling (BIM) education; sustainability (Clevenger et. al, 2018); recruiting opportunities (Wu and Issa 2014; Wu and Issa 2013; Ku and Taiebat 2011); and civil engineering body of knowledge as well as required skills and attitudes.

Several studies have focused on measuring and evaluating student engagement in on-campus courses using online learning systems and in digital learning environments. (Coates 2007) evaluated the use of online systems to enhance campus-based student engagement. The study found that student engagement can be characterized as either intense, collaborative, independent, or passive based on the academic and social levels of the students. Findings showed that students can be more engaged using online systems specifically in independent style of engagement. Another study focused on analyzing the impact of web-based learning technologies on student engagement in face-to-face and online learning environments. The study showed a general positive relationship between web-based learning technology and student engagement and learning (Chen et al. 2010). On the other hand, a study was conducted to analyze the use of the four dimensions of student interaction in online learning environment, including three dimensions originally introduced by Moore's editorial in 1989: (1) interaction with the content, (2) interaction with the instructor, and (3) interaction with the students; and (4) interaction with the online system. The study showed that student interaction is a key element and instructors must overcome psychological and communication gaps that may result from the transactional distance associated with online learning to achieve successful online learning environment (Bouhnik and Marcus 2006; Moore and Moore, 2005). Another study was conducted to measure student engagement in online courses using key engagement factors defined in the National Survey of Student Engagement (NSSE). The study showed that online students reported higher level of engagement as compared to on-campus freshman and senior students in the benchmark of NSSE in the four areas of active and collaborative learning, enriching educational experience, level of academic challenge, and student-faculty interaction (Robinson and Hullinger 2008) On the other hand, Rossin, Ro, Klein and Yi (2009) researched online education literature before 2006 and found that classes designed and developed for face-to-face teaching were not necessarily suitable for online environment

Online programs and course offerings contribute to evolving roles of the teacher and the nature of teaching, with more and more faculty and support staff required for online teaching (Bennett & Lockyer, 2004). Teachers, who are at the center of this increasing demand and pressure to teach online, are being challenged to rethink their underlying assumptions about teaching and learning, and the roles they take as educators (Wiesenberg & Stacey, 2008). As greater attention is placed on online learning, additional research is recommended to evaluate its challenges and opportunities. This research presents a review of existing online construction management and construction engineering management undergraduate, graduate, and certificate programs. The primary contribution of the research is to benchmark existing online construction programs to inform educators of available opportunities for students and, potentially, motivate the development of additional online programs.

Methodology

For this study, researchers performed a review of existing online construction management and construction engineering management undergraduate, graduate, and certificate programs as accessed over the internet between September–October, 2018. Manual search identified four construction management and one construction engineering and management online undergraduate programs; search also identified 17 construction management and four construction engineering and management online graduate programs. While the format of data presented for each program was not consistent from university to university, efforts were made to standardize the data based on authors' understanding and interpretation.

Program Inventory

Online Construction Undergraduate Programs

Table 1 lists the characteristics of the four online construction management undergraduate programs as identified through the internet search.

Table 1: Summary of online construction management undergraduate program characteristics

University	Application Requirements	Degree	Credits	Number of major area courses	Costs	Accreditation
Everglades University	1) Score at least 15 on the University's entrance exam, or a combined score of 1200 on the SAT, or a composite score of 17 on the ACT. 2) TOEFL score of 500 or higher on the paper TOEFL	B.S.	123	42	\$700 per credit	
National University	1) Students without prior college level English and/or Math courses must take the ACCUPLACER mathematics and English evaluation. 2) GPA is 2.0 or higher	B.S.	180	18	\$370 per credit	
Rowan University	Official transcripts from all colleges attended Associate's Degree or 24 semester hours of transferable college credits Minimum undergraduate cumulative GPA of 2.0 (on a 4.0 scale)	B.A.	120	13	\$470 per credit	
Indiana State University	1) Official High School Transcripts. 2) Official SAT or ACT scores.	B.S.	120	25	\$8890 per year in state \$10334 per year Out of State	ACCE

A sample construction management undergraduate program description includes:

Western Carolina University bachelor's degree prepares graduates for positions like project manager, engineer, scheduler and estimator inspector. Students are required to complete one internship in either the summer, fall or spring semester before graduation. (Western Carolina University, n.d.)

Table 2 lists the characteristics of the one online construction engineering management related undergraduate programs identified through internet search. Note that the degree awarded from the University of Southern Mississippi is a Construction Engineering Technology degree.

Table 2: Summary of online construction engineering management undergraduate program characteristics

University	Application Requirements	Degree	Credits	Number of major area courses	Costs	Accreditation
University of Southern Mississippi	1) A 3.2 high school GPA and a submitted ACT (composite) or SAT score 2) 2.5 high school or a class rank in the top 50 percent, as well as a score of 16 or higher on the ACT (composite) or a combined score of 770 or higher in critical reading and math on the SAT 3) 2.0 high school GPA and a score of 18 or higher on the ACT (composite) or a combined score of 860 or higher in critical reading and math on the SAT	B.S.	145	20	\$8,624 per year	ABET

A description of University of Southern Mississippi's Construction Engineering Technology degree includes:

The degree provides skills and knowledge to safely and ethically manage a construction project, by providing a basic understanding of the construction enterprise, history of the built environment, business management, law, technology, engineering, soft skills involving human resource management and project and human safety. (University of Southern Mississippi, n.d.)

All online undergraduate construction management and construction engineering management programs estimated four years to complete their programs with the exception of Everglades University, which stated that the program would take 41 months to finish. Furthermore the one available online construction engineering and management undergraduate program (University of Southern Mississippi) appears to be roughly 65% of the average cost of the four online construction management undergraduate programs.

Online Construction Graduate Programs

A complete list of the characteristics of the 17 construction management graduate programs available online as identified through internet search is available in Appendix A.

A sample construction management graduate program description includes:

East Carolina University offers a Construction Management Master's degree that meets the National Housing Endowment's Gold Standard Residential Curriculum. The program, offered through the College of Engineering and Technology, is one of the largest of its kind in the Southeastern United States and was the first to be accredited in North Carolina through the American Council for Construction Education. Students must maintain a 2.0 GPA and complete an internship with 500 hours of construction work with a state-licensed company before graduating. (East Carolina University, n.d.)

Notably, the construction management graduate programs at the University of Washington Seattle, and Drexel University appear to require 50% more credits to complete the degree than similar programs.

Table 3 presents a summary of the characteristics of the four online construction engineering management graduate programs identified through internet search.

A sample construction engineering and management graduate program description includes:

South Dakota School of Mining and Technology offers a M.S. program in Construction Engineering and Management. This program combines the professional technical skills with the management skills which people need for career development. Students can enroll the program in any one of three semesters throughout the year. Students select core classes and electives based on their personal interests and career goals. The core topics of this program include construction contracts, project management, Construction

company management or Leading and Managing Design Firms, Engineering and Construction Ethics.
(South Dakota School of Mining and Technology, n.d.)

The majority of online master construction management and construction engineering management programs stated that the programs could only be finished in 2 years if students were enrolled fulltime. In general, duration estimates for the various construction management graduate programs ranged from as few as 12 months (University of New Mexico) or 15 months (Southern New Hampshire University) with Clemson University stating that if students were not enrolled fulltime, the program could take up to six years. Estimated durations of construction engineering and management programs ranged from 18 months (Lawrence Technological University) and 19 months (University of Alabama at Birmingham) to two years. In addition, the large majority of programs listed possible start dates to include fall, spring and summer semesters. Finally, none of the online construction management or construction engineering and management graduate programs stated that they were accredited.

Table 3: Summary of online construction engineering management graduate program characteristics

University	Application Requirements	Degree	Credits	Number of major area courses	Costs	Pre-requisites
Columbia University	1) B.S. in Engineering 2) 3.0 GPA in undergraduate degree from a regionally accredited institution. 3) GRE scores are required	M.E.	30	30	\$2018 per credit	Students must complete all core courses and selected electives for a total of 30 graduate points with an academic average of 2.5 or better. Up to 6 credit hours (points) of acceptable graduate-level academic work from an accredited academic institution earned prior to enrolling at Columbia may be transferred as elective credit,
South Dakota School of Mines & Technology	Bachelor's degree from a four-year accredited institution	M.S.	33	25	\$627 per credit	Mathematics to include algebra, basic calculus, probability and statistics. Six semester hours of natural and physical science typically completed as a general education requirement in the fields of geology, astronomy, biology, meteorology, chemistry, and physics. Must include at least 3 credit hours of chemistry or physics.
University of Alabama at Birmingham	1) No entrance exam such as a GRE or GMAT is required for domestic students. 2) BS or BA (any discipline) acquired from any accredited U.S. institution. International students are required to submit GRE and TOEFL scores.	M.E.	30	10	\$700 per credit	Two years of relevant work experience
Lawrence Technological University	1) B.S. in civil engineering (or a comparable technical field) from an ABET-accredited college or university. 2) Minimum overall undergraduate GPA of 3.0.	M.S.	30	18	\$1150 per credit	

Conclusions and Future Work

The number of online programs in higher education and construction is increasing. Online programs and course offerings are evolving the roles of the teacher and the nature of teaching, and this trend may increasingly apply to construction education. This research summarizes results of a manual search for existing construction and construction management online degrees. Findings include a relative homogeneity within undergraduate programs and graduate programs, with the largest category of online programs being construction management graduate programs. The number of credits required for graduation varies more at the undergraduate than graduate level. However, the construction management graduate programs at the University of Washington Seattle, and Drexel University require 50% more credits to graduate than similar programs. The biggest distinguishing feature at the graduate level, however, appears to be admissions and prerequisites requirements. This may, in part, result from the fact that none of the graduate programs were accredited.

At the undergraduate level, the one online construction engineering and management undergraduate program was cheaper than construction management undergraduate programs. On average, at the graduate level, online construction engineering and management programs cost more than online construction management programs. Specifically, online construction management graduate programs were roughly 78-80% of the cost of comparable (public) online construction engineering and management graduate programs. In addition, online construction engineering and management graduate degrees awarded through private institutions such as Columbia and Lawrence Technical University (Table 3) are roughly 180-320% more expensive than degrees from public institutions. While this initial inventory of currently available programs is informative, and supports simple analysis and comparison, additional more comprehensive analysis is needed. Specifically, future research could compare delivery software and/or platforms as well as assess student learning outcomes and other various success metrics. In particular, an analysis quantifying a student's potential return-on-investment, as well as a comparison of perceived value by industry would be beneficial. Finally, qualitative comparison of student as well as teacher experiences involving online delivery of construction education is recommended.

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Appendix A: Summary of online construction management graduate program characteristics

University	Application Requirements	Degree	Credits	Number of major area courses	Costs	Pre-requisites
Purdue University	<p>1) A bachelor's degree in construction management, civil engineering, or a closely related field is recommended</p> <p>2) GPA of 3.00 or better (on a 4.00 scale) from an accredited institution</p> <p>3) Minimum of two years of experience in the construction industry.</p> <p>4) English Proficiency Requirements Vary</p>	M.S.	33	13		
Western Carolina University	<p>1) Computer literacy</p> <p>2) Recommended 3.0 or higher undergraduate GPA</p> <p>3) Interviews may be requested</p>	M.E.	30	19	<p>In State: \$246.57 per credit</p> <p>Out of State: \$756.72 per credit</p>	
Arizona State University	<p>1) GPA of 3.0 in the last 60 credit hours of the student's first bachelor's degree program, or a minimum of a 3.0 cumulative GPA in the last 12 units of the postbaccalaureate transcript.</p> <p>2) A score of 26 on the speaking portion of the TOEFL is required.</p>	M.E.	30	13	\$998 per credit	
Florida International University	<p>Upper division undergraduate GPA less than 3.0, will be admitted conditionally and must earn a cumulative GPA of 3.0 upon the completion of 9 graduate credits within one year. Student may also be required to take the GRE</p>	M.S.	36	15	<p>In State: \$441.49 / credit</p> <p>Additional: \$309 program fee and \$90 online fee</p> <p>Out of State: \$2,100 (flat-fee) per course (3 credits)</p>	<p>Plans Interpretation (Blueprint Reading)</p> <p>Construction Materials, Construction Siftework and Equipment</p>

Louisiana State University	<p>1) A bachelor's degree from an accredited U.S. institution or the equivalent from a foreign institution.</p> <p>2) A grade point average of at least 3.00 ("A" = 4.00) on all undergraduate work (or last half-degree requirement) and a 3.00 GPA or better on any graduate work already completed.</p> <p>3) If you don't meet the GPA or work experience requirement (as defined in the program-specific admissions requirement, if applicable), please submit a GMAT or GRE test score.</p>	M.S.	36	12	\$814 per credit hour	Construction Materials and Methods Construction Estimating Construction Scheduling and Cost Control Structural Principles & Practices Mechanical and Electrical Systems Construction Contracting
East Carolina University	<p>BS or BA degree in construction management, construction engineering, construction technology, civil engineering, architecture, real estate, industrial engineering, mechanical engineering, business, finance, accounting, management, marketing, or related fields.</p> <p>Minimum cumulative GPA of 2.7 on a 4.0 scale</p>	M.S.	30	12	<p>In State: \$249.26 per credit</p> <p>Out of State: \$893.82 per credit</p>	Students must be eligible for MATH 1065, as determined by the ECU Department of Mathematics. Freshman with early college credit are exempt if they have eligible transfer credit for MATH 1065 or 1066.
Drexel University	<p>Acceptable GRE/GMAT score</p> <p>A bachelor's degree in Construction Management, Engineering, Business, or non-technical degree from a regionally accredited university</p>	M.S.	45	29	\$1265 per credit	
North Dakota State University	<p>Have earned a baccalaureate degree in construction, engineering, architecture, or other related discipline with a minimum cumulative grade point average of 3.0 or equivalent to attain full standing.</p>	M.S.	30	10	\$545 per credit	
Clemson University	<p>1) GPA of 3.0 from undergraduate degree</p> <p>2) One year of approved construction industry experience is preferred</p> <p>3) GRE</p> <p>4) TOEFL/IELTS</p>	M.S.	36	/	\$864 per credit	If an applicant does not have an acceptable construction-related undergraduate degree, he or she may need to take one or more of the approved undergraduate courses in the CSM

Southern New Hampshire University	A minimum undergraduate GPA of 2.75	M.S.	36	12	\$610.81 per credit	
University of Alabama at Birmingham	BS or BA (any discipline) acquired from any accredited U.S. institution. International students are required to submit GRE and TOEFL scores.	M.E.	30	10	\$800 per credit	Two years of relevant work experience
University of Houston	1) GRE required for all applicants, and score may not be more than 5 years old. 2) A TOFEL score of 550 is required (international)	M.S.	31	15	In State: \$586.85 per credit Out of State: \$1,101.85 per credit	
University of New Mexico	1) GPA of 3.0 (or equivalent) for courses in the major field of study over the last two undergraduate years. 2)GMAT or GRE General Exam Scores: A minimum score of 500 is required for the GMAT.	M.C.M	30	10	\$372 Per Credit	
University of Southern California	1) Satisfactory cumulative undergraduate GPA (grade point average). 2) Satisfactory GRE or GMAT test scores. 3) TOEFL (iBT) score of 90, with no less than 20 on each section or an IELTS score of 6.5, with no less than 6 on each band score. A bachelor's or master's degree from an accredited college or university in civil engineering or another related discipline such as architecture, business or physical science*	M.C.M	33	18	\$2005 Per Credit	
University of Texas at El Paso	Bachelor's degree in construction management, construction science, construction engineering or civil engineering	M.S.	30	10	\$782 Per Credit	
University of Washington - Seattle	3.0 grade point average (on a 4.0 scale) for the last graded 60 semester credits or 90 graded quarter credits Demonstrated English language proficiency	M.S.	45	19	\$730 Per Credit	