Measuring Construction Internships

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Using the ACCE accreditation standards as the basis for feedback, students were surveyed near the end of their internships on three aspects of readiness to enter the construction industry. They were asked if they understood the information they had been taught, were asked if they were prepared to apply their knowledge in industry and were asked if they had found the information useful in their career. Results were compiled for 34 interns during the summer of 2007. Summary results show that students rank Safety as the most confident item for all three categories, while Design Theory and Accounting rank at the bottom of all three categories. Individual variables were then compared across the three aspects of readiness using a single sample t-test. The t-test showed the greatest discrepancy between student understanding and career value in the areas of Estimating and Accounting.

Key words: internship, construction, ACCE accreditation, construction management

Introduction

The Association of American Colleges and Universities (AAC&U) and the Council for Higher Education Accreditation (CHEA), with support from the Teagle Foundation, recently released a statement of principles for higher education (AAC&U and CHEA, 2008). The goal of the Statement of Principles was to summarize and then implement principles and actions for meaningful educational accountability. Among the principles and actions recommended were reductions in the use of standardized measures, since they address "only a small part of what matters in college" and the development of alternative methods such as student portfolios and senior projects.

Employers dismiss standardized tests in favor of assessments of real-world and applied-learning approaches such as evaluations of supervised internships (Peter D. Hart Research Associates, Inc., 2008). When employers ranked assessment options, multiple-choice tests ranked the lowest value and faculty-evaluated internships ranked the highest value. Employers also highly valued individual student essay tests, electronic portfolios and comprehensive senior projects as methods to evaluate graduates' readiness for the workplace.

The internship experience is a three way partnership among the university, the student and the internship employer (Tovey, 2001). It is the obligation of the university to prepare students for entrance into industry by assisting them with learning objectives, career counseling and internship plans. Employers share a responsibility by providing an orientation and training period and evaluating the student's performance on the job. The student has the responsibility to complete the learning agreement and give their best effort to perform at an acceptable level on the job (Adcox, 2000).

Minnesota State University Mankato (MSU) requires an internship for construction management majors. The internship consists of 15 weeks of full time employment in an approved position

within the industry. Students are required to complete goals and objectives prior to beginning their internship and then complete weekly reports of their activity based on those goals and objectives. The MSU internship supervisor visits each intern and employer on the job site once during their internship experience. At the conclusion of the internship, students write a paper that summarizes what they have learned. The internship experience at MSU most commonly falls at or near the end of the student's educational experience, but may be earlier.

This research is the first phase of an effort to develop effective methods of measuring the student internship experience. Using the three way partnership model, measurement of the internship then involves measuring the educational program of the university, measuring the commitment and needs of the construction industry in the internship process and measuring the student readiness to actively participate in their chosen industry. The current research measured the students' opinions of their own readiness to enter industry.

Literature Review

Service learning, cooperative education, cooperative learning, practicum and internship are terms that are often used interchangeably (Tovey, 2001). They designate student experiential learning outside the university setting, with a goal of preparing students for successful entrance into their chosen field.

The internship experience is a vital aspect of any construction management program (Hager, 2005). Internships have become an integral part of the academic landscape for construction management programs. Student benefits include clarifying career choices and opportunities for permanent placement with the sponsoring company (Hauck, Allen, & Rondinelli, 2000).

Chapin (2003) surveyed the Associated Schools of Construction members in his study and found 91% of the member schools have some type of cooperative education with 58% of those schools requiring the internship program and 42% having an elective program (Chapin, Roudenbush, & Krone, 2003). The internship provides a window to the actual world of work and an opportunity for the student to apply the information learned in their university program to the industry (Hager, Pryor, & Bryant, 2003).

A 2006 study addressed the issue of employers' perceptions of the value of internships. The conclusion of the research was that employers use the internship primarily as a recruiting tool, since the demand for CM graduates is greater than the supply. Employers also found internships to be cost effective for pre-professional staffing and well worth the additional expense (Moore & Plugge, 2006).

In spite of the overwhelming acceptance of internship programs in Construction Management, the American Council for Construction Education (ACCE) does not address the issue of an internship experience in their accreditation standards and the learning that occurs during an internship does not count towards academic hours in any accreditation criteria (American Council for Construction Education, 2007).

The question remains as to whether construction management interns bring an acceptable level of education to the industry, and thus, whether the students are able to assimilate from the internship experience what the industry perceives to be the skills needed to perform effectively. This researcher's review of the literature did not find any research regarding the expectations industry has of interns. However, Chris Souder and Dennis Gier (2006) surveyed contractors in their region about skills that they would like construction management graduates to have as they enter the industry. According to their survey, the four most desired skills are: estimating, plan reading, scheduling and safety. The least needed skills are: graphics, surveying, jobsite layout and temporary structures (Souder & Gier, 2006).

Pilot Survey

A paper based pilot survey was conducted using the computerized estimating and scheduling class, the most senior estimating class in the program. The class consisted of 35 students who participated in the survey. Students took approximately 30 minutes to complete the paper survey. Feedback was solicited from the students regarding both the survey and their education. Most thought the survey was a good tool, especially useful for improving the program. Of note were two student comments of completely opposite nature:

- I would like to see this program improve. I do not think I have learned enough in the time I've been here. The classes are too easy and there is not enough computer work.
- I found the survey to be helpful to not only the department but also as a self reflection on the things that I have learned throughout my college career...and am completely satisfied with the education that I have received through the CM Department.

Table 1: Results of Pilot Study

Topic	Avg Sco
SAFETY	3.25
GRAPHICS	2.82
ESTIMATING	2.79
SURVEYING	2.74
LAW	2.69
METHODS & MATERIALS	2.66
BUS MGMT	2.63
PROJ MGMT	2.53
ACCOUNTING	2.47
A&D CONSTRUCTION SYSTEMS	2.47
SCHEDULING	2.46
DESIGN THEORY	2.10

The results of the pilot study were summarized in Table 1 by combining the Understanding, Preparedness and Career sections. Results showed the students scored the areas of Safety and Graphics as the highest confidence levels, while Design Theory and Scheduling were at the bottom of the list for this group of participants.

Limitations of the Study

The internship program at MSU is restricted to students who have been admitted to the College of Science, Engineering and Technology (CSET) and have declared a major in construction management. Admission to the college requires 32 credits and an advisor's signature and allows students to take upper level classes. There is no control in the research design beyond the college and major admission requirements. Students may take an internship as a junior, as first semester senior or as their final semester in school. The variability of the timing of their internships will likely affect the results of the survey. Further work should separate the results into student academic levels so students who have not taken their senior classes are either excluded from the survey or measured in a separate group.

Students have many different internship experiences, including but not limited to facilities management, residential estimating and project management, commercial estimating, project management and superintendent, and industrial project management. The scope of this research does not limit the internship types and how the specific internship experience affects the student opinion of their own readiness. Further work could separate the results into internship categories in order to determine the preparation level of the MSU interns for the various sections of the construction industry.

At MSU, internship employers are not given a formal orientation to the MSU internship program. The initial contact with the employer is through the student. The job description from the employer must be approved by the internship coordinator, but there is no additional contact from the university to the employer until the site visit. MSU is in process of creating a standardized orientation for internship employers that will help manage expectations for all participants.

This survey also does not measure the skills and abilities that students bring into the program. The confidence levels that students report may come from the information learned during their studies in the MSU Construction Management program or they may have developed the confidence while working in industry prior to their internships.

Method

The method chosen for this section of the research was a survey of the construction management internship students. The survey was created using the American Council on Construction Education accreditation standards (ACCE). ACCE provides an accreditation process to construction management (CM) programs. In order to achieve accreditation, the CM program must align the class syllabi and lecture hours with ACCE standards (American Council for Construction Education, 2007). For this survey, the accreditation topics were formatted into a list of 63 questions to ask the students, seeking their feedback about their readiness to enter the construction industry.

Each of the questions was a variable, with possible answers scored from one to four, with one being the least confident and four being the most confident. Students were not given the option

to mark a question as either neutral or not applicable. Appendix A contains one page of the internship survey with data collected as a sample of the format.

The survey was placed online and a link was created to the survey. The link to the survey was sent to the students after the 12th week of their internship. The interns took approximately 30 minutes to complete the survey on the computer and then submitted it over the internet.

Results were compiled using the MSU data editor. The results were then converted to a spreadsheet. Each question of the ACCE requirements received a separate score, creating a total of 189 variables. The variables were then analyzed using descriptive statistics.

Additionally, comparisons were made between the student responses to Understanding (U) and the student responses to Preparedness (P) by subtracting the mean for each question of the Understanding section from the same question of Preparedness. A single new variable was created that then was analyzed using a single sample t-test. Comparisons were then created between student responses to Understanding (U) and student responses to Usefulness in their Career (C), and between student responses to Usefulness in their Career (C) and student responses to Preparedness (P) in a similar way for each variable on the survey. Variables with P values < .05 are listed in Appendices B, C and D with their associated survey question.

Survey Results

The survey was given to 34 interns during the summer session of 2007, with all 34 responses available for data analysis.

Student responses in the category of Understanding (U), indicate that their confidence level is highest in the areas of Safety, Graphics and Estimating. The three highest scoring individual variables are the three safety topics, with a mean of 3.5. The students scored Scheduling, Accounting and Design Theory as their lowest level of understanding. Thermodynamics and Electricity were the lowest scoring variables in the Design Theory category, while Cost Accounting was the lowest scoring variable in Accounting. Appendix B lists the scores for each variable in the category of Understanding (U) on the survey.

In the student responses to Preparedness (P), the confidence levels were highest once again in Safety, with Estimating as the second highest category. The highest scoring variables in Estimating were Bid Prep, Quantity Take Off and Types of Estimates. The lowest scores were given in Accounting, Analysis & Design of Construction Systems and Design Theory, with the variable Thermodynamics (from the Design Theory section) having the lowest of all the scores. Appendix C lists the scores for each question in the category of Preparedness (P) on the survey.

In the usefulness in Career (C) list of questions, students responded that Safety, Project Management and Graphics were the most significant items for use in their careers. The students scored Documentation (within Project Management) as the highest scoring variable. Thermodynamics, Electricity (both from Design Theory) and Cost Accounting (from Construction Accounting) scored the lowest of all the individual variables while Business Management, Construction Accounting and Design Theory ranked the lowest summary

categories. Appendix D lists the scores for each question in the category of Careers (C) on the survey.

Responses to the three components of the survey, Understanding (U), Preparedness (P) and Usefulness in Career (C) were then compared. A t-test was used to determine the differences between Understanding (U) and Preparedness (P), between Understanding (U) and Usefulness in Career (C) and between Usefulness (U) and Preparedness (P). The survey showed that the categories of Safety, Estimating, Graphics and Project Management were the four skill sets that were both Understood (U) best and where students were most Prepared (P) to enter the construction industry. Data showed significant discrepancy between Preparedness (P) and Usefulness in Career (C), with the topics of Accounting, Business & Management, Estimating and Project Management. The data indicate that students feel prepared but expect they will not find the items to be useful in their careers. The data showed discrepancy between the variables in the Preparedness (P) and Usefulness in the Career (C) categories on the questions of Computer Applications for Estimating and Computer Applications for Project Management. Students indicated that they felt underprepared but that those skills would be highly useful.

Discussion

Students felt most prepared in the area of Safety, which is a very necessary skill on the construction site. Souder and Gier (2006), indicated that Safety was one of the skills contractors most wanted construction graduates to demonstrate. Most of the variables in Estimating ranked high for confidence levels, however students did not feel ready to tackle the computer applications once they enter industry. This item would be an indication that the computerized estimating class should be reviewed for pertinence to the industry. Scheduling is ranked number ten of the 12 categories in the list of Understanding, number seven in the list of Preparedness and number five in the list for value in their Career. Scheduling is also in the top four skills desired by contractors, according to the Souder and Gier (2006) survey. The results indicate that additional curriculum development in the area of scheduling may need to be considered. The topic of Construction Graphics indicates that students are highly confident in the subject. In the Souder and Gier (2006) survey, contractors feel that construction graphics are one of the least useful skills for construction management graduates. The data indicates that the program may have students spend an inordinate amount of time on the topic of Construction Graphics

Summary

The data supplied by the survey brought out some interesting results. The MSU program appears to be in need of revisions in the curriculum for scheduling in order to raise the confidence levels of the students. The students have high levels of confidence in Construction Graphics, but it is not a needed skill in the industry. The MSU program has a strong construction graphics class, which may need to be revised to put less emphasis on the skill.

The survey method proved useful for understanding the student's opinion as to their preparedness for entrance into the construction industry. The three parts of the questions (Understanding, Usefulness in Career and Preparedness) did not provide sufficient significant

data for analysis. The data could have been captured using only the Preparedness section of the survey, rather than asking the students the same question in three different ways.

Further Study

Further study needs to be conducted using the survey prior to the start of the student's internship. A difference in results from the beginning of the internship to the end of the internship would indicate that the internship experience changed the student's perspective in some way. Additionally, the survey needs to be used with the contractors who employ the interns. It would indicate an employer perspective to the preparedness of the student, which would create a comparison to the self assessment performed by the student. Finally, the contractors need to be surveyed to indicate which items they have found to be the most important to their careers, which would supply information as to the relevance of the construction management curriculum as well as a comparison to the perspective shared by the interns.

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Appendix A Sample of Survey

Survey Form

Please take a survey

CM Student Survey

WELCOME TO THE CONSTRUCTION MANAGEMENT INTERN SURVEY

1. **Before beginning the survey, please provide a NON-MSU email address for our records...**

Non-MSU email:

2. **What is the name and title of your supervisor?**

Name/Title:

3. **Please provide the email address of your supervisor: (important to us in contacting him/her later)**

Supervisor e-mail address:

Based on the CM curriculum at MSU, how ready do you think you are for professional practice in the construction industry?

Please rate the following topics in three areas:

1) Your current understanding of the topic

2) Your current preparedness to work with the topic

3) The expected usefulness of the topic in you career

Estimating (CM215-Fund. Of Estimating, CM248-Contract Documents, CM281-Arch. Graphics, CM413-Cost Estimating & Bidding, CM414-Advanced Estimating & Scheduling)

22. I understand this principle.

	Do not understand	Somewhat understand	Understand	Understand very well
Types of estimates and uses	○	○	○	○
Quantity takeoff	○	○	○	○
Labor and equipment productivity factors	○	○	○	○
Pricing and price data bases	○	○	○	○
Job direct and indirect costs	○	○	○	○
Bid preparations and bid submission	○	○	○	○
Computer applications for estimating	○	○	○	○

23. I am prepared to apply this principle.

	Unprepared	Somewhat prepared	Prepared	Very prepared
Types of estimates and uses	○	○	○	○
Quantity takeoff	○	○	○	○
Labor and equipment productivity factors	○	○	○	○
Pricing and price data bases	○	○	○	○
Job direct and indirect costs	○	○	○	○
Bid preparations and bid submission	○	○	○	○
Computer applications for estimating	○	○	○	○

24. This principle will be useful in my career.

	Useless	Somewhat useful	Useful	Very useful
Types of estimates and uses	○	○	○	○
Quantity takeoff	○	○	○	○
Labor and equipment productivity factors	○	○	○	○
Pricing and price data bases	○	○	○	○
Job direct and indirect costs	○	○	○	○
Bid preparations and bid submission	○	○	○	○
Computer applications for estimating	○	○	○	○

Appendix B Results: Understanding (U)

	Sum	Mean	Std. Dev	p value < .05
Business & Management				
u Economics	93	2.74	0.51	
u Accounting	91	2.68	0.59	
u Priciples of Mgmt	108	3.18	0.67	
u Business Law	103	3.03	0.46	
Subtotal Business & Mgmt	**395**	**2.90**		
Subtotal Business & Mgmt				
u Structural Mechanics	96	2.82	0.67	C
u Electricity	87	2.56	0.66	
u Thermodynamics	84	2.47	0.75	C
u Soil Mechanics	89	2.62	0.74	
Subtotal Design Theory	**356**	**2.62**		
Analysis & Design of Construction Systems				
u Civil	99	2.91	0.71	
u Electrical	94	2.76	0.78	
u Mechanical	100	2.94	0.69	
u Structural	103	3.03	0.83	
Subtotal Analysis &	**396**	**2.91**		
Construction Methods & Materials				
u Comp & Properties	92	2.71	0.63	
u Term & Units of Meas	115	3.38	0.55	
u Stand Designations	103	3.03	0.58	
u Conformance & Testing	95	2.79	0.59	
u Products & Interface	96	2.82	0.67	
u Equip apps & Utilization	112	3.29	0.63	
u Comparative cost analysis	100	2.94	0.74	
u Assembly Techniques	105	3.09	0.75	
u Building Codes	97	2.85	0.70	
Subtotal Methods &	**915**	**2.99**		
Construction Graphics				
u Basic Sketching	111	3.26	0.67	
u Graphic Vocab	104	3.06	0.60	
u Detail, scale, content	112	3.29	0.68	
u Notes and Specs	115	3.38	0.60	
u Computer apps for	94	2.76	0.74	
Subtotal Construction	**536**	**3.15**		
Construction Surveying				
u Survey & Layout	95	2.79	0.77	C, P
u Site Organization	100	2.94	0.81	C
Subtotal Construction	**195**	**2.87**		

	Sum	Mean	Std. Dev	p value < .05
Estimating				
u Types of Estimates	103	3.03	0.72	C
u Quantity Take off	110	3.24	0.82	C, P
u Labor & Equip	103	3.03	0.76	C, P
u Pricing and data bases	103	3.03	0.76	
u Direct and Indirect Costs	110	3.24	0.70	C, P
u Bid Prep & Submission	109	3.21	0.81	C, P
u Computer apps for	100	2.94	0.89	C, P
Subtotal Estimating	**738**	**3.10**		
Planning & Scheduling				
u Project planning	93	2.74	0.71	
u Schedule presentation	99	2.91	0.75	
u Network diagramming	86	2.53	0.75	
u Resource allocation	95	2.79	0.88	
u Impact of Changes	102	3.00	0.82	
u Computer apps for	97	2.85	0.93	C
Subtotal Planning &	**572**	**2.80**		
Construction Accounting &				
u Cost accounting	86	2.53	0.66	C, P
u Fixed & Variable costs	101	2.97	0.67	
u Bidding and procurement	101	2.97	0.76	
u Record and reporting	95	2.79	0.73	
u Capial equipment &	91	2.68	0.73	C,P
u Forecasting costs, cash	93	2.74	0.67	
u Payment processes	99	2.91	0.71	C, P
Subtotal Acct & Finance	**666**	**2.80**		
Construction Law				
u Construction contracts	111	3.26	0.57	
u Regualtory environment	96	2.82	0.52	C
u Lien laws	104	3.06	0.65	C, P
u Labor law	96	2.82	0.58	
u Admin procedures to	99	2.91	0.57	
Subtotal Law	**506**	**2.98**		
Safety				
u Safe practices	120	3.53	0.61	
u Mandatory procedures	118	3.47	0.66	
u Compiance, inspection,	119	3.50	0.66	
Subtotal Safety	**357**	**3.50**		
Project Management				
u Concepts, roles,	110	3.24	0.55	
u Labor relations	105	3.09	0.45	
u Admin systems &	104	3.06	0.55	
u Cost control data &	100	2.94	0.78	C, P
u Documentation	112	3.29	0.68	
u Quality control	103	3.03	0.58	C
u Computer apps for PM	95	2.79	1.01	C, P
Subtotal Project	**729**	**3.06**		

N = 34; t-test significance .05; p values < .05; C=Career; P=Preparedness

Appendix C Results: Preparedness (P)

	Sum	Mean	Std. Dev	P Value < .05
Business & Management				
p Economics	84	2.47	0.56	C
p Accounting	80	2.35	0.60	
p Priciples of Mgmt	105	3.09	0.57	
p Business Law	91	2.68	0.47	
Subtotal Business & Mgmt	360	**2.65**		
Subtotal Business & Mgmt				
p Structural Mechanics	81	2.38	0.65	
p Electricity	77	2.26	0.67	
p Thermodynamics	64	1.88	0.77	C
p Soil Mechanics	80	2.35	0.77	
Subtotal Design Theory	302	**2.22**		
Analysis & Design of Construction Systems				
p Civil	83	2.44	0.82	
p Electrical	76	2.24	0.92	
p Mechanical	82	2.41	0.89	
p Structural	92	2.71	0.87	
Subtotal Analysis & Design	333	**2.45**		
Construction Methods & Materials				
p Comp & Properties	86	2.53	0.61	
p Term & Units of Meas	108	3.18	0.58	
p Stand Designations	99	2.91	0.57	
p Conformance & Testing	91	2.68	0.59	
p Products & Interface	83	2.44	0.82	C
p Equip apps & Utilization	107	3.15	0.61	
p Comparative cost analysis	97	2.85	0.61	
p Assembly Techniques	98	2.88	0.64	
p Building Codes	93	2.74	0.71	
Subtotal Methods &	**862**	**2.82**		
Construction Graphics				
p Basic Sketching	103	3.03	0.97	C
p Graphic Vocab	102	3.00	0.82	
p Detail, scale, content	103	3.03	0.87	
p Notes and Specs	106	3.12	0.84	
p Computer apps for Graphic	91	2.68	0.94	C
Subtotal Construction	**505**	**2.97**		
Construction Surveying				
p Survey & Layout	88	2.59	0.86	C, U
p Site Organization	91	2.68	0.91	
Subtotal Construction	**179**	**2.63**		

	Sum	Mean	Std. Dev	P Value < .05
Estimating				
p Types of Estimates	104	3.06	0.81	
p Quantity Take off	105	3.09	0.83	C, U
p Labor & Equip Productivity	97	2.85	0.78	C
p Pricing and data bases	100	2.94	0.81	C, U
p Direct and Indirect Costs	102	3.00	0.78	C, U
p Bid Prep & Submission	106	3.12	0.81	C, U
p Computer apps for	100	2.94	0.89	C, U
Subtotal Estimating	**714**	**3.00**		
Planning & Scheduling				
p Project planning	89	2.62	0.82	
p Schedule presentation	91	2.68	0.81	
p Network diagramming	80	2.35	0.81	
p Resource allocation	93	2.74	0.71	
p Impact of Changes	95	2.79	0.88	
p Computer apps for	93	2.74	0.79	
Subtotal Planning &	**541**	**2.65**		
Construction Accounting & Finance				
p Cost accounting	80	2.35	0.73	U
p Fixed & Variable costs	82	2.41	0.70	
p Bidding and procurement	89	2.62	0.70	
p Record and reporting	90	2.65	0.73	C
p Capial equipment &	81	2.38	0.82	C, U
p Forecasting costs, cash flow	79	2.32	0.73	
p Payment processes	88	2.59	0.74	C, U
Subtotal Acct & Finance	**589**	**2.47**		
Construction Law				
p Construction contracts	102	3.00	0.74	
p Regualtory environment	88	2.59	0.66	
p Lien laws	93	2.74	0.79	C, U
p Labor law	87	2.56	0.75	
p Admin procedures to avoid	93	2.74	0.62	
Subtotal Law	**463**	**2.72**		
Safety				
p Safe practices	117	3.44	0.66	
p Mandatory procedures	114	3.35	0.65	
p Compiance, inspection,	116	3.41	0.61	
Subtotal Safety	**347**	**3.40**		
Project Management				
p Concepts, roles,	100	2.94	0.55	
p Labor relations	99	2.91	0.57	
p Admin systems &	96	2.82	0.67	
p Cost control data &	94	2.76	0.78	C, U
p Documentation	104	3.06	0.85	
p Quality control	99	2.91	0.62	
p Computer apps for PM	97	2.85	0.66	C, U
Subtotal Project	**689**	**2.89**		

N = 34; t-test significance .05; p values < .05; C = Career; U = Understanding

Appendix D Results: Usefulness in Career (C)

Description	Sum	Mean	Std. Dev	p value < .05
Business & Management				
c Economics	74	2.18	0.63	
c Accounting	78	2.29	0.94	P
c Priciples of Mgmt	106	3.12	0.77	
c Business Law	96	2.82	0.76	
Subtotal Business & Mgmt	**354**	**2.60**		
Design Theory				
c Structural Mechanics	97	2.85	0.96	U
c Electricity	79	2.32	0.91	
c Thermodynamics	67	1.97	0.97	U, P
c Soil Mechanics	87	2.56	0.89	
Subtotal Design Theory	**330**	**2.43**		
Analysis & Design of Construction Systems				
c Civil	87	2.56	0.86	
c Electrical	84	2.47	0.86	
c Mechanical	95	2.79	0.88	
c Structural	100	2.94	0.89	
Subtotal Analysis & Design	**366**	**2.69**		
Construction Methods & Materials				
c Comp & Properties	80	2.35	0.81	
c Term & Units of Meas	112	3.29	0.76	
c Stand Designations	100	2.94	0.69	
c Conformance & Testing	87	2.56	0.79	
c Products & Interface	91	2.68	0.77	P
c Equip apps & Utilization	98	2.88	0.77	
c Comparative cost analysis	102	3.00	0.92	
c Assembly Techniques	100	2.94	0.78	
c Building Codes	111	3.26	0.71	
Subtotal Methods &	**881**	**2.88**		
Construction Graphics				
c Basic Sketching	101	2.97	1.00	P
c Graphic Vocab	107	3.15	0.82	
c Detail, scale, content	107	3.15	0.96	
c Notes and Specs	114	3.35	0.69	
c Computer apps for Graphic	92	2.71	1.09	P
Subtotal Construction	**521**	**3.06**		
Construction Surveying				
c Survey & Layout	89	2.62	1.07	U, P
c Site Organization	98	2.88	1.12	P
Subtotal Construction	**187**	**2.75**		

Description	Sum	Mean	Std. Dev	p value < .05
Estimating				
c Types of Estimates	103	3.03	1.14	U
c Quantity Take off	99	2.91	1.42	U, P
c Labor & Equip Productivity	91	2.68	1.39	P
c Pricing and data bases	93	2.74	1.56	U, P
c Direct and Indirect Costs	103	3.03	1.17	U, P
c Bid Prep & Submission	101	2.97	1.38	U, P
c Computer apps for Estimating	88	2.59	1.56	U, P
Subtotal Estimating	**678**	**2.85**		
Planning & Scheduling				
c Project planning	97	2.85	0.82	
c Schedule presentation	100	2.94	0.81	
c Network diagramming	91	2.68	1.01	
c Resource allocation	105	3.09	0.71	
c Impact of Changes	109	3.21	0.81	
c Computer apps for scheduling	104	3.06	0.89	U
Subtotal Planning &	**606**	**2.97**		
Construction Accounting &				
c Cost accounting	79	2.32	0.94	U, P
c Fixed & Variable costs	86	2.53	0.90	
c Bidding and procurement	98	2.88	0.98	
c Record and reporting	92	2.71	0.97	P
c Capital equipment &	81	2.38	0.95	U, P
c Forecasting costs, cash flow	85	2.50	0.90	
c Payment processes	90	2.65	1.07	U, P
Subtotal Acct & Finance	**611**	**2.57**		
Construction Law				
c Construction contracts	110	3.24	0.65	
c Regualtory environment	100	2.94	0.81	U
c Lien laws	105	3.09	0.97	U, P
c Labor law	100	2.94	0.78	
c Admin procedures to avoid	100	2.94	0.85	
Subtotal Law	**515**	**3.03**		
Safety				
c Safe practices	116	3.41	0.82	
c Mandatory procedures	115	3.38	0.85	
c Compiance, inspection,	119	3.50	0.79	
Subtotal Safety	**350**	**3.43**		
Project Management				
c Concepts, roles,	108	3.18	0.72	
c Labor relations	107	3.15	0.74	
c Admin systems & Procedures	106	3.12	0.69	
c Cost control data &	106	3.12	0.69	U, P
c Documentation	116	3.41	0.66	
c Quality control	106	3.12	0.84	U
c Computer apps for PM	110	3.24	0.70	U, P
Subtotal Project	**759**	**3.19**		

N = 34; t-test significance .05; p values < .05; U = Understanding; P = Preparedness