

Desirable Attributes and Skills for Graduating Construction Management Students

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Construction is a fast paced and ever changing industry that requires continuous focus on academic curriculum to suit the current needs of the industry. Educational institutions that are responsible for preparing undergraduate and graduate students need a strategic plan to adequately prepare the construction managers of tomorrow, who are knowledgeable as well as competent, to be able to better manage the ever increasing complexity of the construction industry. As a first step to developing this strategic plan, this paper investigates the most important skills that today's construction industry requires from graduating construction management students. This research examines a skill set prepared via preliminary surveys, by means of structured surveys directed to various industry stakeholders in order to identify the key skill set desired by the industry from today's passing out undergraduate construction management students. The significance of the study is that it identifies the key knowledge areas; personal and professional attributes; skills; and expertise that academic curriculums in construction management programs need to focus on in order to develop a strategic plan to adequately prepare graduating students entering today's modern and complex construction industry. The study concludes that knowledge of health and safety regulations, interpreting contract documents, listening ability/ giving attention to details, knowledge of building codes and regulations, and time management are the five most important skills desirable in a new hire in construction management.

Key Words: Desirable Skills, Attributes, Construction Management, Graduating Students.

Introduction and Background

Construction is a fast paced and ever changing industry. With construction accounting for a major percentage of the economic thrust of the world, there is undoubtedly a demand for professionals with skills needed to successfully manage construction projects. There are several issues that drive this demand. Firstly, construction projects by their very nature are complex and costly undertakings, with several players ranging from insurance companies to lawyers to engineers to, of course, unskilled laborers. Secondly, construction is a very vibrant field, with an ever changing facet. It adapts to the new technology and new construction methods and the projects being very varied from simple residential types to huge scale commercial types to very highly specialized engineering structures to buildings with a unique architectural styles. The construction firms/ contractors/ management firms have to appropriately manage each type of project to successful completion. Thirdly, over time, the construction industry has evolved from a linear trend of owner, architect, engineer, contractor type relationships to several more complex types of project delivery mechanisms. Fourthly, in today's fast paced world, the construction industry has become increasingly complex considering the challenges of competitiveness, productivity and litigation. Fifthly, most of today's developers and owners seek to outsource various phases of construction projects; hence further increasing the need for professional construction project management.

Construction managers serve as moderators between owners, engineers, architects, quantity surveyors, contractors, subcontractors and insurance agents. The skills which a construction manager brings to a company largely determine the success of its projects.

The business and construction industry is becoming increasingly global and the role of the project management professional now includes many front-end services, which increases the required skill set of new graduates (Choudhury, 2000; Kay, 2001). Project management is no longer a special-need management (Arain, 2005a). Alternative contractual delivery systems, collaborative partnerships, new management initiatives, and global product markets require professionals and students to have a broader awareness of construction methods and project management issues. An increasing percentage of the typical firm's effort is being devoted to projects. The future promises an increase in the importance and the role of projects in contributing to the strategic

direction of organizations (Arain, 2005b). In the developed world, many academic disciplines inside and outside of project management education have successfully used study abroad programs as an effective means of broadening project management students' academic, personal, and professional views of the world (NASFA, 2003). Bryde (2003) discussed different terms which have emerged since the beginning of 1990's to describe the project management approach. These terms include: modern project management, management-by-projects, projects (project management) culture, and beyond the Gantt chart.

Construction Management Responsibilities and Skill Requirements

The major tasks in construction management include planning, organizing, scheduling, implementing, managing, monitoring, controlling, and tracking construction projects. Construction professionals must learn the various project management areas or body of knowledge (Baharudin, 2006, Egbu (1999) based on his study concluded that of the 75 types of management skill and knowledge, the six most important are leadership, communication (oral/written), motivation of others, health and safety, decision making, and forecasting and planning. These skills when imbibed in a construction professional can yield better results. Young (1989) identified skills and knowledge in organization, human relations, communication, personnel management and operational planning to be the most important in the practice of construction management. Baharudin (2006) cited other skills required such as the understanding of engineering, architectural, and other construction drawings; good oral and written communication skills; and leadership skills. Good working relations with diverse groups of people, as in with the owners, other managers, designers, supervisors, and tradesmen are most important for construction professionals. The already employed or the new recruits in the field of construction management need to successfully and timely adopt the needed skills.

Role of Construction Management Programs and Educational Institutions

Students who seek this initial exposure and expertise to construction management often pursue an undergraduate degree program in construction management. The students getting into the management schools come from different backgrounds, skills, knowledge and experience to finally get into a common stream of construction management. More recently there has been a trend of professionals from other non-construction based disciplines who are attracted to the realm of construction. These established professionals who range from finance to business science backgrounds seek new skills and expertise by entering the construction industry through the Masters of Science Construction Management programs. The schools need to best utilize this opportunity to make the students gain the exposure to the outside world from the classroom itself. This also helps the students who may not have the experience in management, in particular the international students who come from different cultural bases.

The prospective students to construction management programs always look for the missions, goals, objectives and the course curriculum of the programs and decide on the school they wish to join. But they may sometimes miss out on that there might be a gap between what they are being given and what they really need after graduating.

Consequently, the construction management programs must be constantly revamped and enhanced to address the education needs of these students, and hence the industry. The value of well defined and structured courses as well as industry experience and feedback must be inclusive to the program. Hence the educational institutions that are responsible for preparing undergraduate and graduate students need a strategic plan to adequately prepare the construction managers of tomorrow.

How this Study Can Help?

Lack of an adequate education in management skills for project and construction managers is one of the factors contributing to the decline in the effectiveness of the industry. There is an urgent need for owners, architect/engineer firms, construction management firms, and contractors to recognize that this shortcoming exists. But they should be heartened by realizing that the problem can be reduced by strengthening the capacity and the effectiveness of colleges and universities in their teaching and research efforts.

As a first step to developing a strategic plan for improvement of construction management education for institutions offering programs in construction management, this paper identifies the most important skills that today's construction industry requires from students graduating from undergraduate construction management programs. Based on the findings of a preliminary survey identifying the key positions and duties assumed by today's new-hire construction management students in the industry, this research develops a comprehensive

skill set perceived to be desirable by the industry. This skill set is then examined by means of structured surveys directed to various industry stakeholders in order to identify the key skill set desired by the industry from today's passing out undergraduate construction management students.

The significance of the study presented in this paper is that it identifies the knowledge areas; personal and professional attributes; skill; and expertise that academic curriculums in construction management programs need to focus on in order to develop a strategic plan to adequately prepare graduating students.

Objectives and Scope

The objectives of the research are outlined below:

- To identify the key skill set required by today's construction industry from graduating construction management students (both undergraduate and graduate).
- To determine whether the existing construction management curriculums satisfy the skill demands of the construction industry in terms of graduating students performing professional duties and responsibilities as needed.
- To research construction management programs offered in other countries and compare and contrast these to those in the US.
- To develop a strategic plan for construction management curriculum improvement at the undergraduate and graduate academic levels as an integrated plan of interdisciplinary and synergistic learning.

Owing to paper length restrictions, the scope of the research presented in this paper is limited to identifying the desirable skill set for students graduating from undergraduate construction management programs only. Further research findings will be presented in subsequent papers.

Methodology

Graduate and undergraduate programs instigate different skills, knowledge, and expertise; students are trained according to their prospective future assigned positions and tasks performed. In order to develop an initial skill set to be diagnosed and investigated further, a preliminary survey was done to identify the key positions and key duties that graduating construction management students assume in the industry as new hires. The preliminary survey was targeted to two corporate managers in construction firms and three senior project managers, all responsible for hiring construction management graduates in their organizations/ projects.

In the second stage of the study, based on extensive literature review and results of preliminary survey, a comprehensive skill set was developed, categorized in a number of key areas applicable to the knowledge, attributes, skills and expertise required from graduating construction management students. These key areas included: 1) personal attributes; 2) professional attributes; 3) technical skills; 4) managerial skills; 5) industry and business skills; 6) people skills; and 7) legal and contractual skills. In developing the skill set, the literature review was done through books, conference proceedings, internet, and leading construction management and engineering journals (in particular: Baharudin, 2006; Egbu, 1999; Young, 1989).

In the third stage of the study, an examination of the current needs of the construction industry (knowledge, attributes, skills and expertise) from graduating construction management students was performed based on the comprehensive skill set produced in stage two. This was done via structured questionnaire surveys targeted to professionals from varied disciplines, specialties, fields of construction and levels of management.

Survey Design

The structured questionnaire survey consisted of two parts – A and B. Part A requested respondent's personal information (e.g. work experience, position in company) and company information (e.g. type of organization, types of construction works performed, years in business, annual volume of work, number of employees).

Part B consisted of a construction management skill checklist which was prepared as a combined result of extensive literature review and preliminary survey. In this part, a series of questions was tailored to evaluate the importance that current professionals value as the most important desirable skills from graduating construction management students. A list of potential skills, knowledge areas, and attributes was provided to the respondents. The survey asked the respondents to give a score for how they felt about the various knowledge areas, attributes, and skills required from new hires in the construction management field. A Likert scale was used to establish the

level of significance of each skill. A score of 5 was given if the skill in question was considered extremely significant by the respondent and a score of 1 was given if the skill in question was considered extremely insignificant. A score of 3 meant that the skill in question has average level of significance to the respondent. A couple of follow up questions were also included to get an understanding of what construction professionals expect and require from employees entering the workforce with undergraduate construction management degrees.

The survey was distributed to firms in South Florida ranging in size from small, local companies to large, multinational corporations. A total of 85 questionnaires were distributed, and 46 were completed and returned within the timeframe requested. The results of the surveys were analyzed and compiled. The findings are detailed in the next section.

Results

Preliminary Survey

The responses on prospective positions, in descending order, are given in the following table. From the findings, it is evident that most graduating students are placed as project engineers.

Table 1
Positions offered to graduating construction management students

Position	Percentage Response
Project Engineer	80%
Scheduler	35%
Estimator	32%
Assistant PM	15%
Project Coordinator	7%
Project Manager	3%

Also, the key duties assumed by these new hires were diagnosed. The responses on prospective duties, in descending order, are given in the following table.

Table 2
Key duties of newly hired undergraduates

Duty	Percentage Response
Facilitating Project Manager	78%
Document Control & RFI Logs	74%
Field Coordination & Monitoring	70%
Submittal Review & Approval	70%
Planning Review & Permitting	66%
Scheduling and Progress Reporting	62%
Payment Application & Reports	58%
Decision Making & Cost Analysis	54%
Estimating	50%
Control of Close Out	46%

Based on the above findings, it can be concluded that it is imperative that graduating construction management students must possess adequate knowledge, skills and expertise in order to perform their routine duties (as indicated in the table above); a comprehensive skill set, categorized in subsections according to key skill areas, was generated as a result. This is discussed in the next section.

Structured Survey

Questionnaire Response Rate

The response rate for completed questionnaires is shown in Table 3. This response rate is considerably good for a construction industry questionnaire survey. In similar type of surveys, Panthi et al. (2007) received a response rate of 19.4%, Ahmed and Azhar (2004) received 30.4% and Wang et al. (2004) received a rate of 7.75%. Baker (1998) reported that statistically reliable conclusion can be obtained from a sample size of 20 or more.

Table 3
Breakdown of Responses

Total questionnaires sent	Questionnaires returned uncompleted	Total number of potential questionnaires	Total valid responses received	Percentage of valid responses
85	6	79	46	54%

Respondent Characteristics

The respondents were divided into two groups regarding their types of organizations. The first group is "owners" which represents 26.67% and includes representatives from project owners, developers, architect/ engineering firms and project management firms. The other group is "contractors" which represents 73.33% and includes representatives from general contractors, subcontractors, and design-constructors.

The respondents who participated in the questionnaire survey were professionals drawn from architecture, engineering, and construction disciplines. The respondents with respect to their positions were: architects (7%), civil engineers (13%), corporate managers (13%), senior project managers (19%), project managers (28%), project coordinators (7%), and superintendents (13%). Almost all of them had over 10 years of construction industry experience, and more than 65% respondents had over 15 years of experience.

Skill Analysis

The respondents were requested to evaluate 93 skills deemed significant for graduating construction management students, on a five-point scale starting with 1 for least degree of importance and 5 for highest degree of importance. The mean level of significance for each skill (based on the scale rating of responses) was calculated to obtain the importance index for each skill. The importance indices are then ranked from the highest to the lowest for overall respondents for each category of skill. Tables 4-10 show the ranking and the mean level of significance for various categories of entry-level skills as perceived by the respondents. Skill criticality has been divided into three zones: minor – mean level of significance range between 0 and 2.50, moderate – mean level of significance range between 2.5 and 3.75, and major - mean level of significance range between 3.75 and 5.00.

Table 4
Key Skills/ Attributes – Personal Attributes

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
<i>I</i>	<i>Personal Attributes</i>		
1	Listening ability/ Giving attention to details	4.65	Major
2	Time Management	4.58	Major
3	Dependability	4.49	Major
4	Personal adaptability/ Flexibility	4.45	Major
5	Desire to learn	4.44	Major
6	Assertive attitude	4.38	Major
7	Promptness in actions	4.27	Major
8	Comprehension ability	3.98	Major
9	Ability to learn	3.88	Major
10	Innovative mindset/ Creativity	3.62	Moderate
11	Willingness to travel (when required)	2.63	Moderate

Table 5.
Key Skills/ Attributes – Professional Attributes

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
II	<i>Professional Attributes</i>		
12	Hands-on project experience prior to graduation/ Internship	4.48	Major
13	Teamwork capabilities	4.47	Major
14	High regards to values/ Work ethics	4.33	Major
15	Planning and goal setting	4.27	Major
16	Long term commitment	4.17	Major
17	Problem solving/ Analytical skills	3.97	Major
18	Result orientation	3.78	Moderate
19	Critical path thinking	3.68	Moderate
20	Decision making skills	3.63	Moderate
21	Forecasting	3.62	Moderate
22	Ability to follow up	3.23	Moderate
23	Risk taking	3.18	Moderate
24	Multi-tasking	2.87	Moderate

Table 6.
Key Skills/ Attributes – Technical Skills

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
III	<i>Technical Skills</i>		
25	Plans interpretation/ Blueprint reading/ Understanding construction & shop drawings	4.54	Major
26	Knowledge of construction operations	4.47	Major
27	General computer proficiency	4.29	Major
28	Proficiency in construction information technology/ software	4.23	Major
29	Knowledge of green and sustainable construction/ LEED	4.08	Major
30	Scheduling	4.03	Major
31	Knowledge of project closeout and handover procedures	4.03	Major
32	Estimating	3.84	Major
33	Cost accounting	3.66	Moderate
34	Knowledge of construction materials	3.58	Moderate
35	Knowledge of construction equipment	3.54	Moderate
36	Economic and financial analysis	3.27	Moderate
37	Knowledge of design	3.09	Moderate
38	Value engineering / Constructability analysis/ Design Review	3.04	Moderate
39	Scope review	2.83	Moderate

Table 7.
Key Skills/ Attributes – Managerial Skills

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
IV	<i>Managerial Skills</i>		
40	Health and Safety management	4.79	Major
41	Quality assurance/ Total Quality Management	4.43	Major
42	Inspection/ Quality control	4.34	Major
43	Organizational	4.27	Major
44	Document control	4.23	Major
45	Project management/ administration	4.18	Major
46	Cost control	4.13	Major
47	Leadership	4.12	Major
48	Team building	3.99	Major
49	Site planning and management	3.93	Major
50	Personnel/ Resource management	3.92	Major
51	Risk planning, assessment and control	3.78	Major
52	Productivity management	3.73	Moderate
53	Managing labor issues	3.42	Moderate
54	Knowledge and information management	3.03	Moderate
55	Financial management	2.74	Minor

Table 8.
Key Skills/ Attributes – Industry and Business Skills

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
V	<i>Industry & Business Skills</i>		
56	Knowledge of health and safety regulations	4.84	Major
57	Knowledge of building codes and regulations	4.62	Major
58	Knowledge of environment impact assessments	4.49	Major
59	Marketing with clients/ Developing client relations	4.48	Major
60	Knowledge of the permitting process	4.45	Major
61	Construction trade knowledge	4.43	Major
62	Understanding procedural issues	4.38	Major
63	Understanding cultural issues	4.12	Major
64	Understanding complementary fields/ disciplines	3.98	Major
65	Awareness of industry trends	3.93	Major
66	Appreciation of construction industry supply chain	3.84	Major
67	Understanding geographical issues	3.62	Moderate
68	Construction organization management/ Business management	3.62	Moderate
69	Entrepreneurship	3.49	Moderate
70	Partnering	3.16	Moderate
71	Understanding global construction environment	2.87	Moderate
72	Understanding lean culture	2.13	Minor

Table 9.
Key Skills/ Attributes – People Skills

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
VI	<i>People Skills</i>		
73	Written communication	4.34	Major
74	Verbal communication	4.29	Major
75	Diversity	4.19	Major
76	Trade coordination	4.18	Major
77	Ability to speak different languages/ Multilingual	4.12	Major
78	Meetings	4.07	Major
79	Managing relationships/ Networking/ Collaboration	3.94	Major
80	Motivation capabilities	3.67	Moderate
81	Negotiations/ Conflict resolution	3.62	Moderate
82	Coaching	2.20	Minor
83	Mentoring	2.18	Minor

Table 10.
Key Skills/ Attributes – Legal and Contractual Skills

S. No.	Skill/ Attribute	Mean level of significance (on a scale of 5)	Skill Criticality Zone
VII	<i>Legal and Contractual Skills</i>		
84	Interpreting contract documents	4.73	Major
85	Knowledge of construction law and legal environment	4.52	Major
86	Contract administration skills	4.23	Major
87	Knowledge of bidding procedures	4.18	Major
88	Dispute avoidance and resolution skills	4.17	Major
89	Knowledge of project delivery and contracting strategies	3.99	Major
90	Change management	3.93	Major
91	Understanding labor laws	3.77	Major
92	Claims preparation and presentation skills	3.12	Moderate
93	Claims defense skills	1.62	Minor

Summary of Analysis

After analyzing Tables 4 through 10, the most desirable set of skills for graduating construction management students as perceived by the industry, ranked in descending order of importance (based on mean level of significance values), are shown in Table 11.

The mean level of significance showed that the most important skills are: Knowledge of health and safety regulations (4.84), Interpreting contract documents (4.73), Listening ability/ Giving attention to details (4.65), Knowledge of building codes and regulations (4.62), and Time Management (4.58).

Further assessment of Tables 4 to 10 – to identify importance ranking of various categories of skills (based on a value of mean level of significance for each category) – results in Table 12. The table has been arranged in descending order of skill category importance.

Table 11.
Most Desirable Skills – Various categories

Rank	Skill/ Attribute	Skill/ Attribute Category	Mean level of significance (on a scale of 5)
1	Knowledge of health and safety regulations	Industry & Business Skill	4.84
2	Interpreting contract documents	Legal & Contractual Skill	4.73
3	Listening ability/ Giving attention to details	Personal Attribute	4.65
4	Knowledge of building codes and regulations	Industry & Business Skill	4.62
5	Time Management	Personal Attribute	4.58
6	Planning and goal setting	Professional Attribute	4.54
7	Plans interpretation/ Blueprint reading/ Understanding shop drawings	Technical Skill	4.54
8	Knowledge of construction law and legal environment	Legal & Contractual Skill	4.52
9	Hands-on project experience prior to graduation/ Internship	Professional Attribute	4.48
10	Knowledge of construction operations	Technical Skill	4.48
11	Marketing with clients/ Developing client relations	Industry & Business Skill	4.48

Table 12.
Skill Importance Ranking - Various Categories

Skill/ Attribute Category	Mean Level of Significance ¹ (on a scale of 5)	Skill Category Criticality Zone	Skill Category Ranking
Personal Attributes	4.12	Major	1
Managerial Skills	3.94	Major	2
Industry & Business Skills	3.91	Major	3
Professional Attributes	3.82	Major	4
Legal and Contractual Skills	3.82	Major	4
Technical Skills	3.77	Major	6
People Skills	3.71	Moderate	7

¹Mean level of significance for a category is the sum of significance indices for each skill/ attribute in the category divided by total number of skills/ attributes in the category

Conclusions

To adequately equip the construction managers of tomorrow with better construction project management skills, an integrated curriculum should be considered to present the distinct components of the construction process in a synergistic, project based environment. The key skills desirable from such a construction management program have been identified in this paper. Based on the results of the study, the following conclusions have been drawn.

The top five (5) skill/ attribute categories are given below. Their mean significance values (maximum 5) are given in parenthesis: 1) Personal Attributes (4.12); 2) Managerial Skills (3.94); 3) Industry & Business Skills (3.91); 4) Professional Attributes (3.82); and 5) Legal and Contractual Skills (3.82). This is to say that skills in above categories share a major average (mean) position of importance.

The top twelve (12) most important skills desirable from graduating construction management students (across the nine categories given above) are shown below. Their mean significance values (maximum 5) are given in parenthesis: 1) Knowledge of health and safety regulations (4.84); 2) Interpreting contract documents (4.73); 3) Listening ability/ Giving attention to details (4.65); 4) Knowledge of building codes and regulations (4.62); 5) Time Management (4.58); 6) Planning and goal setting (4.54); 7) Plans interpretation/ Blueprint reading/ Understanding construction and shop drawings (4.54); 8) Knowledge of construction law and legal environment (4.52); 9) Hands-on project experience prior to graduation/ Internship (4.48); 10) Marketing with clients/

Developing client relations (4.48); 11) Knowledge of construction operations (4.48); and 12) Communication (4.47).

Future Directions

Based on the findings, a strategic plan for construction management curriculum improvement can be developed at the undergraduate level as an integrated plan of interdisciplinary and synergistic learning which can improve the knowledge and skills of the graduating students. To improve the curriculum of the undergraduate level, curriculum management audits should be introduced. Curriculum auditing is a useful process for school systems seeking improvement of the quality of design and delivery of curriculum in the schools. Other than this, individual school audits, curriculum development and design services and training, examining student work for alignment with state standards and testing should be adopted.

The survey results and the strategic plan can be utilized to improve nationwide construction management programs as well as strengthen the capacity and effectiveness of colleges and universities in their teaching and research efforts.

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