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Analysis of Qualifications for Entry-Level Positions in Construction Management

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Construction management graduates must possess a mixture of technical, soft, and technological skills in order to fulfill their job responsibilities as a project engineer, estimator, field engineer, etc. at the start of their career. There is a lack of information on the exact skills that are required of a recent graduate to occupy these entry-level positions in the construction industry. This study analyzed job listings in order to understand most common qualifications expected of graduates and their most common responsibilities in construction. The researchers qualitatively analyzed a group of 40 companies that rendered 64 listings for data collection. It was found that qualifications in job listings referenced mostly soft skills, whereas responsibilities referenced technical skills the most. The listings were analyzed to find representation of Student Learning Outcomes (SLOs) as well. It was observed that job responsibilities represented more SLOs than the qualification sections. The findings from this study could be used by institutions to bring their construction management programs up to current industry expectations. Recent and upcoming graduates can use these findings to understand the skills they need to possess to work in their desired positions in construction.

Introduction

Construction graduates usually occupy a plethora of professional positions within the construction management sector [1]. For example, previous research found that recent construction graduates may occupy or assist with positions such as project engineer, field engineer, scheduler, estimator, project manager [2]. Furthermore, depending on the company and project scope, some of these construction management positions can have varied responsibilities including, but not limited to, surveying, performing quality control, assisting in gathering quantities of work put in place, documenting information, helping foremen with understanding drawings and specifications, assisting in preparing schedules and maintaining inventory control.

To fulfill these responsibilities efficiently, construction graduates must possess a mix of skills that involve discipline-specific knowledge, interpersonal skills, and some level of technological skills. Several researchers have explored this topic previously from a knowledge, skills and attitude (KSA) perspective or a work readiness perspective [1-4]. For example, utilizing an exploratory factor analysis, Ahn et al. [3] have identified four key competencies of construction graduates working in American construction companies. These key competencies encompass general, affective, cognitive and technical skills. The emphasis on soft, or more interpersonal skills, suggested in Ahn et al. [3] was also found by other researchers evaluating competencies of construction students [5, 6].

Given the importance of the topic to construction education, several researchers have explored the key skills necessary for young construction graduates entering the job market. However, much of the previous research has focused on technical and soft skills, without in-depth exploration of the technological skills expected of young graduates. This is relevant given the rise of construction 4.0 and the impact of technology in construction activities and professional roles [7]. Furthermore, most research utilized survey procedures (including students, professionals and experts), which provides useful information but does not take into consideration what is directly requested by companies. This is important because ultimately,

these are the skills being portrayed to job applicants. At this time, only Subedi [8] analyzed skills using more objective measurements, such as construction job descriptions. Their findings confirm the focus on soft skills, most specifically inter- and intrapersonal skills, with the ability to work in teams appearing as desirable in more than half of the analyzed job postings. Therefore, the present research aims to address this gap by studying entry-level job listings that are open to recent graduates in the construction management sector. The analysis will study the following research questions:

1) What are current required qualifications for entry-level construction-related positions?
    - Which technical, soft and technological skills are required?
2) Which skills are most commonly used to fulfill responsibilities for entry-level construction-related positions?

At the present stage, our research is exploratory and will focus only on the American context, for entry-level positions requiring a construction-related undergraduate degree. Furthermore, the researchers will discuss the applicability (and limitations) of the present method for researchers considering a similar approach.

In addition to informing other researchers about the research method, our findings can be used by: (1) construction program instructors and administrators to enhance their programs by comparing skills mostly required by companies to current American Council for Construction Education (ACCE) Student Learning Outcomes (SLOs) in their curriculum objectives; (2) senior construction students and recent graduates to assess their current skills and competencies required for their desired positions in the construction sector and provide benchmark information to construction companies about how these positions are being advertised; and (3) construction companies looking to benchmark which technical, soft and technological skills that are frequently desired for entry-level construction-related positions.

Background Literature

To start, a review of current literature was conducted to understand previous research undertaken in similar directions, which identified skills and abilities of operation personnel in construction management or other fields. Research in construction-related education was studied to identify recent trends about technical, technological, and soft skills of recent graduates. We complement our review of literature by adding papers from other domains that have explored a similar method of analysis.

Technical, Technological and Soft Skills in Construction

In the present paper, technical skills are defined as the fundamental knowledge of a specific field. Some key technical skills previous research has identified include interpretation of plans, knowledge of construction operations, general computer proficiency, knowledge of green and sustainable construction, scheduling, estimating, and safety, among others [2, 5]. Technical skills have found to be extremely important for construction students' job readiness by both industry professionals and students [5]. In their research, Bhattacharjee et al. [5] compared the perceptions of students and industry professionals on desired skills and knowledge required for construction career success. Upon analyzing responses from both groups, it was found that students and industry professionals agreed that knowledge of construction document

interpretation, OSHA safety regulation, quality control, scheduling and estimating are quintessential. However, there was some disagreement on the importance of interpersonal skills as students believed management skills and only oral communication was expected of them, instead the industry believed trust and honesty, written and oral communications, and critical thinking were necessary. Furthermore, a survey study conducted in the United States by Souder and Gier [9] aimed to improve the CM program at their university by seeking feedback from construction companies. Analyzing the responses, conclusions such as emphasizing on project administration skills, project delivery systems, interpretation of plans, safety, and business skills were deemed important for achieving the aim [9], further emphasizing the needs for technical skills for construction professionals.

Soft skills, on the other hand, do not relate to any specific task, rather they are required in any position since they refer to relationships with other people in the organization [10]. In the present research, these skills include what Ahmed et al. [2] defined as personal and professional attributes and people skills. Since a construction project typically requires coordination of numerous people, it is essential that employees have certain set of soft skills that can aid in the success of the organization as shown by recent studies. Previous and recent research has emphasized the need for soft skills, including interpersonal skills for construction graduates. Previous research suggests that soft skills are very important for superintendents [6]. Moreover, recent research in the construction domain has identified valuable soft skills for professionals of this industry, including teamwork, effective interpersonal skills, excellent oral communication, attention to detail, reliability, flexibility and working in a fast-paced environment [8].

Despite its importance, previous research [11] found that construction graduates are increasingly lagging in soft skills due to a number of reasons such as lack of standard definition of ‘soft skills’, unclear understanding of expectations related to the use of soft skills in industry, scattered efforts to reduce this gap and lower emphasis by accreditation bodies, when compared to technical skills. It was observed that it is challenging to quantify the cultivation of soft skills in the curricula. Vaz-Serra and Mitcheltree [12] used a survey to collect data of key competencies required from Construction Management graduate students in Australia from the perspectives of senior executives and operation heads that have recruitment powers. Through their analysis, top five traits were identified: communication, resilience and persistence, emotional intelligence, commitment to personal development, and commitment to professional development.

In addition to the so called technical and soft skills, the use of computerized technology in the construction industry has been increasing in recent times, to reduce physical labor and increase accuracy, efficiency, and productivity. Workers can be assigned to safe and less labor-intensive tasks, while dangerous and difficult work can be automated [7]. Technologies that are being increasingly adopted include robotic and sensing systems, technologies related to building information modeling and simulation, information digitization and virtualization, as well as automation through artificial intelligence and machine learning [13]. In the present paper, skills associated with the use of these technologies and equipment to support technical tasks with enhanced capabilities are called technological skills. Entry-level graduate employees can act as ambassadors for advanced technologies, by adapting quickly and play an instrumental role in changing beliefs of skeptical senior management [14]. Thus, it can be understood that construction professionals must be proficient in technical skills, use computerized technologies for their application and possess soft skills to coordinate workers and tasks towards successful project completion.

These research efforts are mostly aimed at providing recommendations to CM programs for improving their curricula, consequently preparing students for the industry in a better way. For example, Bhattacharjee et al. [5] recommended to increase industrial exposure of students through site visits, internships, job shadowing, guest lectures, etc. Pathuri et al. [15] suggested that their findings can help mid-level managers advance by working towards acquiring the top KSAs. CM graduate programs can benefit by incorporating these KSAs as short-term courses. Gunderson and Gloeckner [6] recommended construction firms to develop training and mentoring sessions to prepare skilled superintendents that can alleviate the superintendent gap their research observed in the industry. Souder and Gier [9] suggested CM programs to utilize their conclusions to develop curricula. Since the construction industry continuously evolves, this literature certainly lags today. Many current technologies have been adopted in this decade, while preparing for use of their further advanced versions.

Reviews of methodologies adopted

Previous literature was mainly focused on surveys [2, 5, 6, 9, 12, 15]. Pathuri et al. [15] used the Delphi study technique to collect information on KSAs through open-ended questions. At this time, only Subedi [8] analyzed skills using more objective measurements, such as job descriptions. Using publicly available job postings data, they performed statistical analysis to study educational qualifications, types of soft skills demanded, and experience required. Hoffman and Bresciani [16] researched skills and competencies expected from new employees in student affairs positions. They utilized qualitative analysis as the first stage which was followed by mixed model analyses. The first stage was performed to explore answers to a similar research question as ours. Another research by Gonzales [17] focused on finding most demanded programming languages for librarians, which of them are preferred by employers and which were required by jobs. They analyzed over 478 jobs posted in a span of a decade. These postings were collected by web scraping and then coding was performed without a specific mention of the software used. Our research methodology adopted a similar approach for collecting data of job listings and then qualitative analysis was performed.

Methodology

This study collected data from entry-level job listings publicly advertised by companies in the first months of 2022. Because of the exploratory nature of this research, data collection was limited to publicly available job listings of the 74 companies that were members of the Purdue University School of Construction Management Technology (SCMT) Construction Advisory Council (CAC) at that time. CAC member companies were invited to share their publicly available job listings with the researchers and for those companies that did not provide data, an online search using web scripting was performed to collect the information when allowed and possible. Data collection was delimited to:

- First, construction-related positions requiring or preferring a bachelor's (4 year) degree were selected,
    - Following, at least one of the degrees listed is in a construction related field (e.g.: BS in construction engineering; BS in construction management) or general engineering.

- Full time positions (no internships).
- Positions that require no previous full-time experience or there was no specific mention to required previous experience.

Data from files received and websites were cleaned to extract information such as job location, experience and minimum education requirements, skills required and responsibilities. This information was entered in spreadsheets using Microsoft Excel, creating separate files for each listing. These spreadsheets were later merged into a single file and converted into a document which was imported in NVivo 12 Pro, a software tool for qualitative analysis. NVivo allows for creation of overarching themes as nodes. Nodes were created for educational and experience requirements. Then, nodes for responsibilities and qualifications were created. Within the 'qualifications' node, subnodes for soft skills, technical skills and technological skills were included to answer the first research question of the present study. A similar approach was used for job responsibilities. Additional subnodes were created when necessary to identify emerging themes within the data and reporting will focus only on the third-level emerging themes for main job responsibilities. Figure 1 shows a visual of the data coding process and levels. We note that the level of detail in the description of job listings varied greatly among companies, with some companies including several lines of information for qualifications and responsibilities, while others including just a few lines. Results are presented as frequencies of job listings mentioned in each emerging theme.

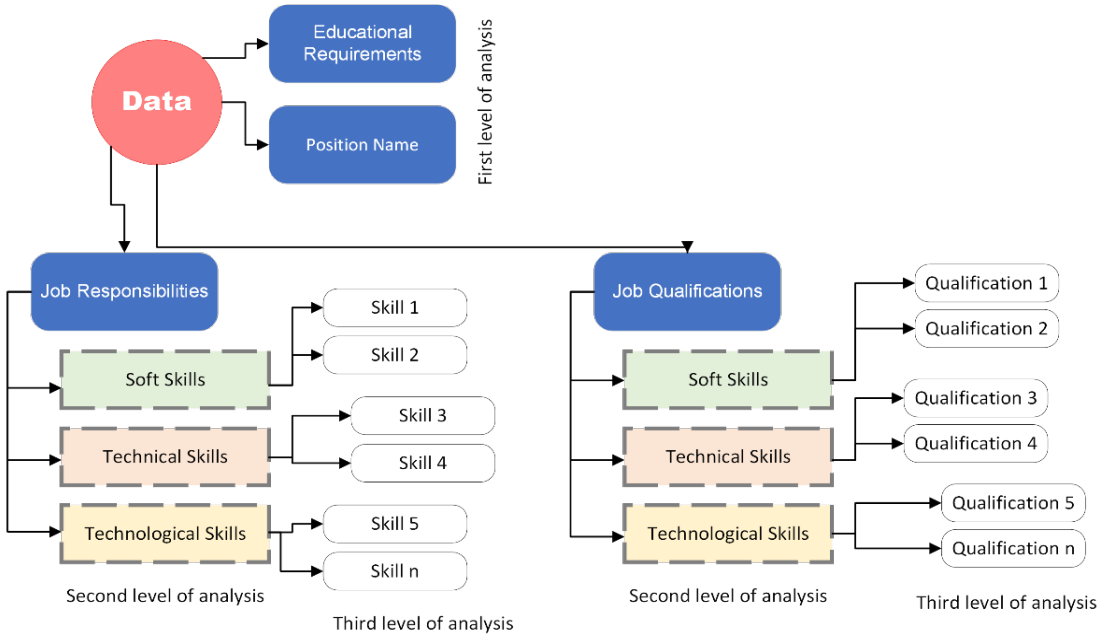

Figure 1. Coding levels for the data analysis

Finally, coding was implemented to represent the American Council for Construction Education (ACCE) Student Learning Outcomes (SLOs) [18]. The SLOs were matched to third-level subnodes created for job responsibilities and qualifications. Similarly to qualifications and responsibilities skills, results are presented as frequencies of job listings that presented a certain SLO.

Results

A total of 40 companies had at least one entry-level job listing that matched the requirements for the present study. Of those companies, 22 had one applicable listing, 13 had two applicable listings, four had three applicable listings and one company had four applicable listings, totaling 64 applicable listings. We note that one organization had more than 20 job listings, each with multiple locations, that were eligible to be included in this study. However, since the rest of the companies had one to four job listings at most, the inclusion of these listings might have caused bias in the data. Hence, to avoid this effect, three listings from this organization were randomly selected to be included in the present study.

Most of the job listings were for engineering positions. For the 64 positions, most were for project engineers (n=35), followed by field engineers (n=9), estimators (n=6), project managers or assistant project managers (n=4), others, which include positions with multiple names (n=4), VDC or BIM engineer (n=3), office engineers (n=2) and assistant superintendent (n=1). These findings help to identify which position names best align with recent construction graduates.

In terms of geographical location, CAC-member companies represent local, regional and national organizations. Because of that, geographical location was analyzed based on the listing location and the United States (US) Census Regions and Divisions map was used for this categorization [19]. This analysis was somewhat complicated because some positions included multiple locations. On average, each posting had 3 potential locations (minimum of one and maximum of 16) and Table 1 includes the breakdown of number of locations per job listing. Eight positions did not disclose a location in the job listing. For the present study, the researchers assumed that despite multiple locations, only one position was represented by each job listing. For the 64 positions studied, 189 locations were indicated. Most job postings were for positions located in 3 of the 9 US Census divisions: Mountain (n=37), East North Central (n=36), Pacific (n=32), while the New England had none. Figure 2 includes the breakdown for all the identified locations per job listings.

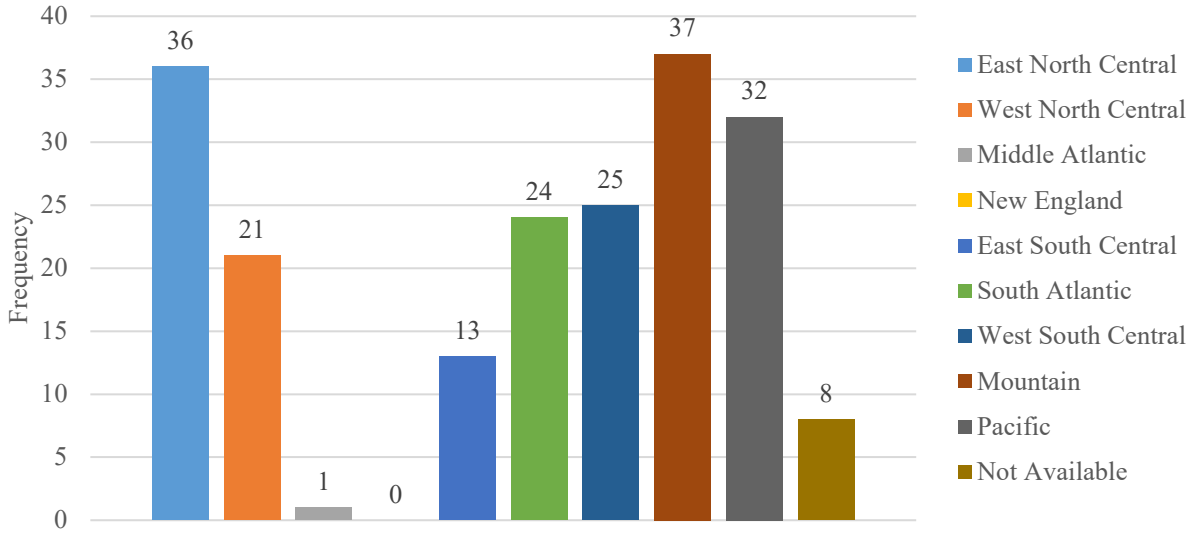

Figure 2. Breakdown for the location US census region per job listing

Table 1. Number of locations per job listing (n=64)

Number of locations	Number of job listings
No location disclosed	8
1	34
2	4
3	5
4	0
5	3
6+	10
Total	64

Of the job listings analyzed, six indicated a preference for a college degree, while 37 indicated a requirement for a degree and the remainder 21 indicated that the degree could be substituted by either experience or a combination of technical education and experience. Furthermore, most of the surveyed job listings included reference to a construction-related degree (n=59), followed by a requirement of an engineering degree (n=28), a civil or structural degree (n=16) and architecture degree (n=11). Other listings accounted for 11 mentions and one just stating, "degree in an applicable field". Job listings often included more than one degree option for the positions. This finding highlights the synergies between other AEC degrees.

Most of the participating companies (n=40) performed mainly commercial construction, followed by mainly heavy civil, namely industrial or infrastructure (n=4) and mainly residential (n=1). In this case commercial work included also healthcare, hospitality, and mixed used buildings. Moreover, the vast majority was either general contractors or construction managers or a combination of both (n=31), followed by subcontractors (n=8) and developer (n=1). For both of these classifications, the researchers used publicly available information to classify each company into one type, though we understand certain companies may provide different arrangements or perform services in multiple sectors.

Current Entry Level Qualifications:

As the results of first coding process, soft skills were referenced in the qualifications of 56 listings, technical skills were referenced in 39 listings and technological skills were referenced in 38 listings. Following, we explain the main themes found withing these three major skills.

First, the majority of referenced soft skills were communication skills (n=50), followed by organizational (n=44) and interpersonal (n=41) skills, then behavioral attributes (n=30) and leadership skills (n=7). Communication, organizational and interpersonal skills had a median frequency of 1 mention per job listing, while behavioral attributes and leadership skills had 0. Figure 3 includes word clouds for the four most cited types of soft skills categories used in this analysis and helps to understand the differences between them. A word cloud could not be successfully run for leadership skills due to the low frequency of mentions.

Figure 3. Word-clouds for soft skills types

Within communication skills, most of the references included mention of both written and verbal communication skills. Furthermore, 32 listings required communication skills to be “strong, optimal, excellent, effective”. It is interesting to note that assessment of these qualities is often reserved to the judgement of job interviewer or work supervisor. Verbal and written skills were explicitly mentioned in 21 listings, while 3 listings mentioned a need for listening skills as well, such as “Ability to listen and understand intents and goals,” and 2 mentioned presentation skills. This broadening suggests that graduates need to understand communication in a wider sense.

Moreover, organizational skills is defined here as a broad category including analytical skills, as well as skills associated with the efficiency, accuracy and productivity of a task. Analytical skills were mainly understood as problem-solving skills and were found in 24 listings. Productivity skills were found in 34 listings and included mentions to time management and attention to detail. Examples of excerpts coded at this level include: “good time management and prioritization skills,” and “detail orientation sufficient to organize and manage multiple project tasks.”

Within interpersonal skills, there were many mentions to interaction with different project stakeholders, such as client, owner, architect and subcontractors. Furthermore, an interesting term was observed: 'customer service skills' or 'customer orientation' which suggests rethinking the relationships between stakeholders (including internal stakeholders) as customer relations. Also, within interpersonal skills, there were 29 listings that explicitly mention the need for he ability to work in teams.

In addition to the previously mentioned skills, behavioral attributes were also mentioned in the job listings. Some of these attributes included a growth or learning mindset, self-motivation and ethics. In fact, 11 listings explicitly mentioned the need for ethics or integrity, such as "demonstrated commitment to ethics and integrity." Finally, leadership skills were not frequently mentioned, which would be expected as our scope was entry-level positions. Yet, 7 listings included some requirement in leadership skills, ranging from just mentioning "leadership skill" to "experience with leadership in some capacity." This suggests the position might involve managing direct reports or supervise crews.

Though technical skills were mentioned in the qualification requirements for less listings than soft skills, these skills had a larger thematic spread. Most likely due to this large spread, all themes under technical skills had median of 0. Twenty-three of the 39 listings included mentions to construction principles and techniques, such as "working knowledge of construction principles highly desirable" or "ability to apply fundamentals of the means and methods of construction management," suggesting that no specific principles or techniques are required, but an overall understanding of these is expected. Following the 'construction principles and techniques' theme were 16 listings that mentioned an ability to read drawing and specifications, and 11 listings required some level of safety knowledge or awareness. It was also interesting to see the requirements for knowledge about lean construction and principles mentioned in five listings as a job qualification. Table 2 has the breakdown of the top 10 themes found for technical skills in qualifications.

Table 2. Emerging themes in technical skills qualifications

Ranking	Theme	Number of job listings
1	Construction principles and techniques	23
2	Read drawings, plans and specifications	16
3	Safety	11
4	Field operations	8
5	Contract administration	7
6	Codes, standards	5
7	Estimating and 1uantity take off	5
8	Lean Construction and related principles	5
9	Management	5
10	Quality assurance and quality control	4

Technological skills were referenced in 38 listings. Similar to technical skills, themes within this skill had all a median value of zero reference per listing. Emerging themes were created for software skills, general technological skills and skills related to tools and equipment. However,

tools and equipment were referenced only in one listing and included references to drones, photogrammetry capture and processing, and LiDAR capture. Five listings include general skills, without much specification, some examples are “excellent computer skills” or “knowledge of required construction technology.” Finally, most listings actually included specific software mentions, with the overwhelming majority citing Microsoft Office Suite, followed by construction or project management software, such as Prolog or Procore. Table 3 includes the ranking of software categories found on the data.

Table 3. Most frequently mentioned software needed as qualification for positions

Ranking	Software categories	Number of job listings
1	Microsoft Office Suite	26
2	Construction or project management software	12
3	Drafting software (e.g., AutoCAD)	11
3	Scheduling software	11
5	AEC collaboration software (e.g., Bluebeam)	9
5	Building Information Modeling (BIM) related software and procedures	9
7	Other	8
8	Estimating software	4
9	Earthworks software	1

Current Entry Level Responsibilities:

Content regarding job responsibilities was analyzed in a similar way as the qualifications. Results from the analysis indicate the technical skills (n=62) were more frequently mentioned than soft (n=41) or technological skills (n=19) in order to fulfill job responsibilities. This is opposite to results from qualifications, which had major content related to soft skills. Furthermore, technological skills seem to be mostly attached to job qualifications, and not so much for responsibilities. For a comparison between the skills and qualifications and responsibilities, see figure 4.

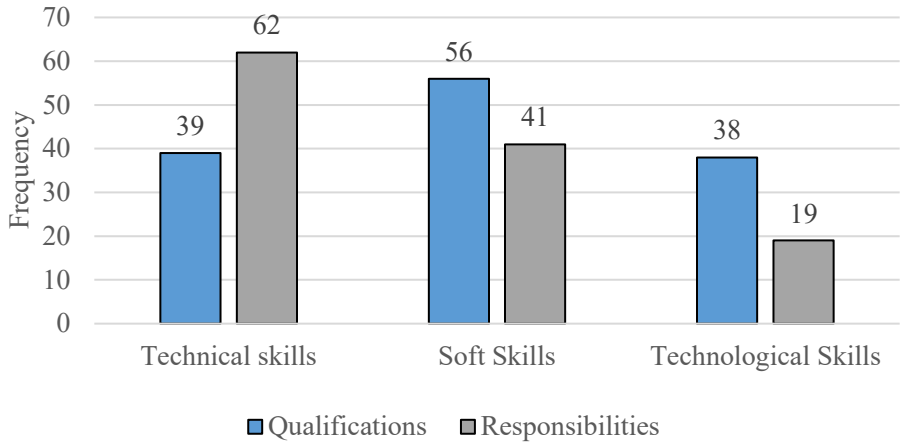

Figure 4. Comparison of frequencies of soft, technical, and technological skills in qualifications and responsibilities

Soft skills had the same breakdown in themes as in the qualifications. However, differently than in qualifications, interpersonal skills were more frequently required of graduates (n=24), mostly related to teamwork and managing stakeholder collaboration and interaction. Following, 17 listings mentioned the use of communication skills, focusing again on the effective collaboration between project parties. Organizational skills (n=8), behavioral attributes (n=7) and leadership skills (n=3) were seldom mentioned as responsibilities.

As mentioned previously, 62 listings mentioned some technical skills as part of job responsibilities, which seems aligned with expectations. Further analyzing the data into emerging themes, project management (n=46), field operations (n=37), and safety (n=35) were the top three mentioned technical skills used in job responsibilities. Furthermore, seven themes within technical skills had a median above 0, which indicate the common themes required for job responsibilities of recent graduates. Table 4 includes the breakdown for the top 10 emerging themes of technical skills in responsibilities, and figure 5 includes a word-cloud of all the themes gathered within technical skills in responsibilities, displaying the 100 most frequent words in each coded theme.

Table 4. Emerging themes in technical skills qualifications

Ranking	Theme	Number of job listings	Median
1	Project management	46	1
2	Field operations	37	1
3	Material and equipment management	35	1
3	Safety	35	1
5	Estimating and quantity take off	34	1
6	Scheduling	33	1
7	Project controls (including cost control)	32	0.5
8	Quality assurance and quality control	31	0
9	Document control	29	0
10	Drawing, plans and specifications	29	0

Figure 5. Word-clouds for technical skills used as job responsibilities.

We also note that project management was a broad category created and included many of the organizational aspect of running a project, such as coordinate meetings, requests for information (RFIs) and change orders. This category is closely aligned with soft skills of communication and interpersonal skills, but because most of the writing was very applied to a project setting, it was classified as technical skills. Examples include: "participating in / documentation of project coordination meetings," and "initiate, prepare, review, track and distribute RFIs."

Within field operations, responsibilities included often daily logs, site logistics and field supervision. This seems to suggest that several entry-level positions are related to site operations. Furthermore, material and equipment management related to tracking, receiving, and ordering material to site, such as the following excerpts illustrate: "requisition [of] third party rentals via the purchasing department and maintain onsite rental equipment logs," "assist in material expediting." As can be seen, both themes are related and highlight the on-site nature of most of the listings.

Finally, in terms of technological skills, only one mention to specific technological tool was found in the data. This mention describes the need to take photographs for weekly project reports. Furthermore, three listings mentioned the use of technology without further specifying them, such as "utilize cutting-edge technology to assist on assigned projects." Seventeen listings mentioned specific software use. On those, we found mentions to BIM-related software and procedures, followed by construction or project management software, and drafting software to be the most frequent. Microsoft Office Suite was only mentioned in two listings as part of job responsibilities. Table 5 includes the full breakdown.

Table 5. Most frequently mentioned software used as part of positions' responsibilities

Ranking	Software categories	Number of job listings
1	BIM-related software and procedures	8
1	Construction or project management software (e.g. Procore)	5
2	Drafting software	4
3	Other	4
3	AEC-collaboration software (e.g. Bluebeam)	3
6	Estimating software	3
6	Scheduling software	3
6	Microsoft Office Suite	2
9	Earthworks software	1

Student Learning Outcomes (SLO):

The created nodes for qualifications and responsibilities were matched with the 20 SLOs that each ACCE-accredited curriculum must cover in their four-year bachelor's program [18]. SLOs were referenced in responsibilities content of 61 listings and qualifications content of 60 listings. An issue we had with this analysis was that the SLOs did not perfectly match with the nodes since the SLOs have a very direct objective and listings are not formulated according to them. For example, SLO 3 stands for ability to create construction project safety plan. None of the analyzed listings mentioned the creation of a project safety plan as part of the job responsibility. However, several listings referenced safety in them. Some of the references were: "learn to

perform safety audits", "support our zero-injury safety program", "promote a "zero injury" culture by completing hazard recognition cards, conducting inspection walks." Thus, it can be observed that the fundamental of SLO 3 is observing strict adherence to safety protocol and that is found to be represented in the listings. A similar procedure was followed for all SLOs, noting that (1) due to the nature of the emerging themes, some SLOs were not captured or were captured just in part in the results, and (2) some SLOs are complex in nature and could be involved in multiple emerging themes, such as SLO 9 can be tied to teamwork (soft skills), but also some aspects of project management (technical skill). Therefore, we were not able to precisely match certain emerging themes with SLOs, such as some of the soft skills (interpersonal skills, leadership skills and organizational skills), and technical skills (for example field operations and project management) emerging themes. Furthermore, SLOs 1 and 2 were matched in a joint manner to communication skills since they stand for both written and verbal communication skills. Figure 6 explains visually how the authors conducted the matching of SLOs.

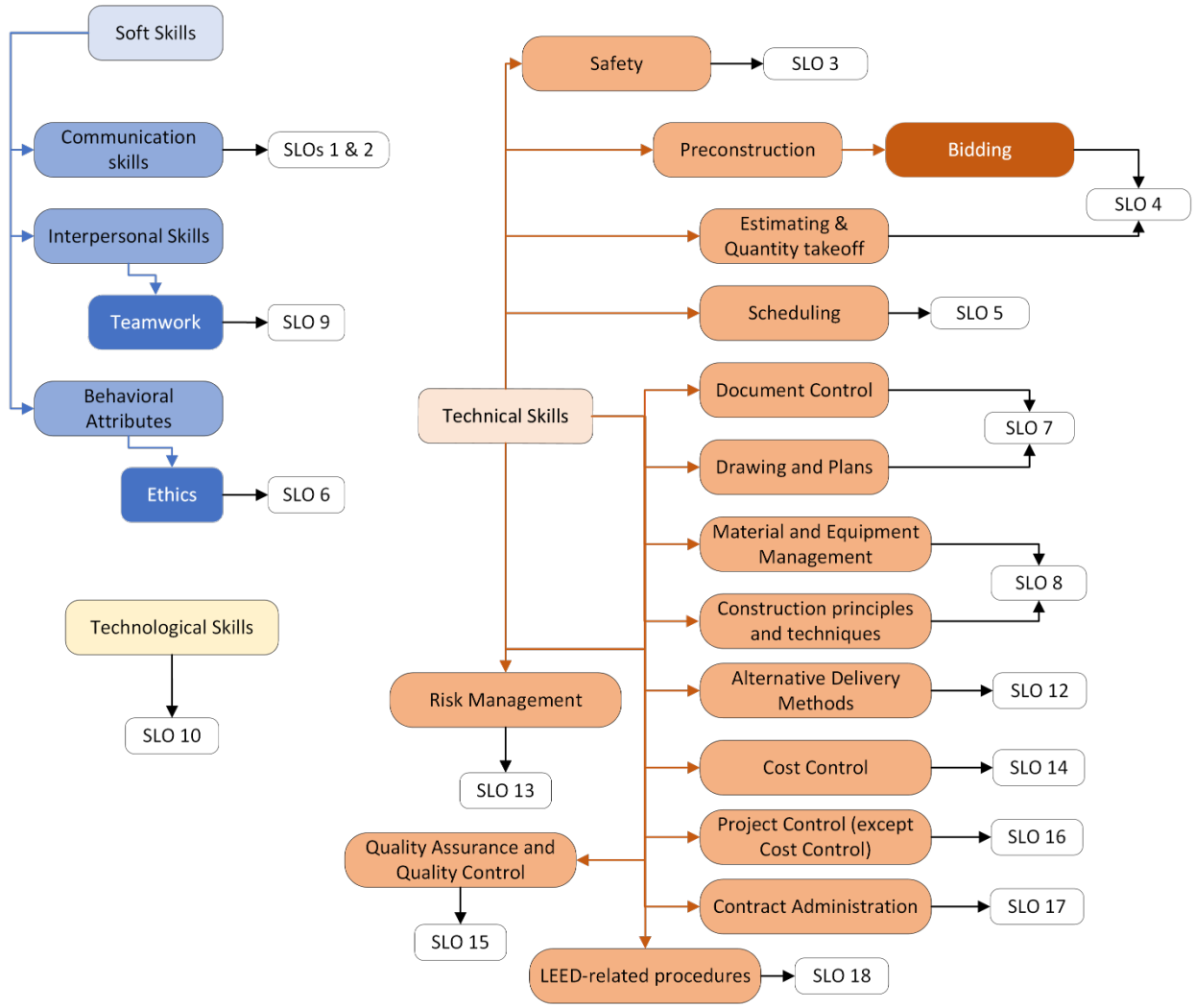

Figure 6. Visual representation of emerging themes matched per SLO

Table 5 includes a breakdown of the frequency of SLOs mentioned in the qualifications and responsibilities emerging themes. We note that three SLOs were not mentioned neither in the qualifications nor in the responsibilities. For them (SLOs 11, 19 and 20), it is possible that they might have been seldom mentioned and are captured within emerging themes that in included in other SLOs.

Table 5. Frequency of job listings that can be related to SLOs

Student Learning Outcomes (SLOs)[a]	Qualifications	Responsibilities
SLOs 1 & 2 – Communication	50[b]	17
SLO 3 – Safety	11	35[b]
SLO 4 – Cost Estimates	7	25
SLO 5 – Scheduling	2	24
SLO 6 – Decisions based on ethical decisions	11	2
SLO 7 – Construction Documents	18	42[b]
SLO 8 – Construction Methods, Materials & Equipments	23	36[b]
SLO 9 – Effective member of multi-disciplinary team (partial)	29	6
SLO 10 – Technology	34[b]	15
SLO 11 – Construction Layout and Control	0	0
SLO 12 – Delivery Methods	1	1
SLO 13 – Risk management	0	7
SLO 14 – Accounting and Cost Control	2	23
SLO 15 – Quality assurance and control	4	31
SLO 16 – Project control	0	14
SLO 17 – Legal implications	7	26
SLO 18 – Sustainable construction	0	2
SLO 19 – Structural Behavior	0	0
SLO 20 – MEP Practices	0	0

[a] SLOs names are abbreviated. Full SLO descriptions can be found in [18].
[b] Denotes median of 1 frequency per listing, as opposed to a median of 0 for all other SLOs

Our results, which should be taken with caution due to the limitations mentioned previously, suggest that SLOs 3, 7, 8 ,15 and 17 make up for the majority of responsibilities, while SLO's 1 & 2, 8, 9 and 10 account for the near entirety of qualifications. Interestingly, SLOs that were mostly mentioned in the qualifications were usually less mentioned in responsibilities and vice-versa. Technology, which was also a focus of the present study was far more mentioned in qualifications than in responsibilities. Representation in responsibilities also seems to be more uniform, unlike in qualifications, where it seems to be clustered towards only a few SLOs. Furthermore, some SLOs were seldom mentioned in both qualifications and responsibilities, such as SLOs 11, 12, 18, 19 and 20. It could be argued that some of those provide foundational understanding of construction principles, such as 11, 12, 19 and 20. However, more research could be done to explain the low representation of SLO 18, given that sustainability is a topic that has increased interest in the past decade.

Discussion and Conclusion

The present research explored the most common qualifications and job responsibilities evident in job listings for entry-level positions in the construction management industry. Sixty-four job listings were analyzed with regards to the job location, educational requirements, experience requirements, desired qualifications, and job responsibilities. Qualitative analysis was performed to identify emerging themes under overarching domains of soft skills, technical skills and technological skills present in qualifications. These domains were utilized to code skills that are required to fulfill the job responsibilities. ACCE-approved SLOs were matched to emerging subnodes to quantify their presence in these listings.

In qualifications content, soft skills were referenced more than technical and technological skills. Thus, suggesting that organizations deem the completion of a four-year program is equivalent to having gained the necessary technical skills. Furthermore, our findings show less emphasis on technological and technical skills as part of qualifications, which can suggest that those skills can be acquired as one starts working hands-on on projects. The major soft skills that were referenced were communication skills, organizational skills, interpersonal skills and behavioral attributes such as positive attitude, self-motivation, ethical behavior, proactiveness, etc. This is in agreement with the industry professionals perspective findings of Bhattacharjee et al. [5]. Few of the five traits identified by Vaz-Serra and Mitcheltree [12] such as, communication, commitment to personal and professional development, also emerged in this analysis. Coding for technical skills returned knowledge of construction principles and techniques, drawings and plans, safety systems and field operation as most commonly referenced qualifications. This is different than previous findings [5] that rendered technical skills such as knowledge of construction document interpretation, OSHA safety regulation, quality control, scheduling and estimating as important. However, knowledge of drawings and plans, and safety systems appear in the findings of Souder and Gier [9] as essential to students of construction management programs.

In responsibilities content, technical skills were referenced more than soft skills and technological skills. This can be attributed to the fact that daily job responsibilities involve the utilization of technical skills to a greater extent that the soft skills. Furthermore, our results show a focus on the use of project management and field operations knowledge. This prevalence of field operations knowledge could be due to a greater number of project/field engineer positions than office related positions, however not all positions were clear about whether they were for field or office, such as project engineer positions. The findings about technical skills by Bhattacharjee et al. [5] are actually found to be similar to that of this research. Field operations, preconstruction, material and equipment management, project management, safety, and scheduling are the major technical skills emerging in responsibilities content. For soft skills, it was interesting to see a focus on interpersonal skills, which is expected due to the collaborative nature of construction industry.

Finally, the exploration of SLOs representation in job listings rendered interesting results. It was observed that different SLOs were mainly represented in the outlined qualifications and responsibilities in job listings. Responsibilities mainly contained SLOs related to construction documents (SLO 7), construction methods, materials and equipment (SLO 9) and construction safety (SLO 3), while qualifications focused on communication (SLOs 1 & 2), technology (SLO 10) and working effectively in multi-disciplinary teams (SLO 9). Furthermore, the content of job

listings related to responsibilities was much further spread out across several SLOs, while the content about qualifications was focused mainly in seven of the twenty SLOs. Thus, it can be said that the job responsibilities for entry-level positions appear to be better synchronized with the construction management programs than qualifications for these positions. Furthermore, it seems qualifications relate more to soft and technological skills, while responsibilities relate more to technical skills. Finally, it was noted that a few SLOs were rarely mentioned in both qualifications and responsibilities, such as construction layout and control (SLO 11), delivery methods (SLO 12), sustainable construction (SLO 18), structural behavior (SLO 19) and MEP practices (SLO 20). Some of these could indicate that these topics are foundational knowledge, however it seems concerning that very few job listings require or apply knowledge related to sustainable construction.

Limitations and Suggestions for Future Research

The limited number of job listings available for analysis is the major limitation of this research, but it was deemed adequate for its exploratory nature. Additionally, some of the listings were excluded because they did not specifically require a construction-related undergraduate degree, even though they were for construction-related positions.

Future research can address these limitations by using a larger number of companies, categorizing technical skills and soft skills by using a list of ACCE SLOs as starting point, and also including positions that do not require a construction-related degree. Other suggestions for future research include adding other domains in the analysis, such as business and entrepreneurial skills; compare findings for different positions, such as a comparison between field engineer and project manager, and for different industry segments, such as specialty building systems subcontractors, heavy civil and commercial contractors. Inclusion criteria can be expanded to include positions with requirement of 1-2 years of experience since that will represent students who might have completed internships. Expansion towards including positions requiring 4-year civil engineering degree exclusively is possible, since it is tightly integrated with construction engineering and that will allow for inclusion of positions like structural engineer or transportation engineer, just to name a few.

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