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Assessing Industry Estimating Software Utilization Practices to Improve Construction Education

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Estimating is an essential part of any construction firm and a core subject in construction management education. Construction faculty should make every effort to align their courses with the needs of industry. A survey was completed by members of the American Society of Professional Estimators and the McWhorter School of Building Science Industry Advisory Council to determine what software was most prevalently utilized in industry for material quantification and cost estimating. A total of 186 practitioners responded to the survey. On-Screen Takeoff and Bluebeam were found to be the most commonly used software for material quantification and Microsoft Excel for cost estimating. Most respondents did not utilize BIM for material quantification but did consider that functionality as valuable when assessing new software. The results of the survey built on similar previous research both of industry and academic practices. Specific differences in the research findings are highlighted, and recommendations for construction faculty are provided. Future research should seek to understand software utilization by construction estimating faculty to compare with industry practices.

Key Words: Estimating, Construction Education, Software

Introduction and Literature Review

Estimating is an integral and essential part of construction management programs in the United States. For example, the American Council for Construction Education requires that accredited construction programs show how each graduate meets the student learning outcome “Create construction project cost estimates” with “create” being the highest level of cognition. How estimating is taught has changed over time to comply with changes in technology, and the needs of industry. For example, Bender (2004) details how the estimating curriculum was sequenced and taught at Central Washington University, concluding that “Any estimating instruction must include a curriculum that is based on students putting pencil to paper”. More current research has focused on ways to engage students through hands-on experiential learning (Collins & Redden 2021), as well as through technology (Zhu & Issa 2017, Eberhardt et al. 2018, Elliot et al. 2019).

Leveraging computers and their various software platforms to complete daily tasks is standard in almost every industry today, including construction. The marketplace of construction software is vast, sometimes difficult to navigate, and ever changing. Construction firms have been analyzing and incorporating computer technology into their processes since personal computing devices were made widely available in the 1980's. Similarly, construction academics have been diligently integrating technology into their classrooms over the same timeframe and disseminating those practices. For example, early Associated Schools of Construction (ASC) proceedings included publications from Keeter (1987) that discussed teaching project cash flow projections using spreadsheets at East Carolina University, and Hein et al. (1989) that discussed integrating contract management software into classes at Auburn University.

Deciding which software to incorporate into a curriculum or a certain class, is not always an easy choice to make, especially in relation to estimating. A simple search engine query into "best construction estimating software" will provide a myriad of options, including established platforms, and new up and coming solutions. Several authors have sought to cull this list via surveying other construction management programs to determine what they have incorporated. For example, Engelhardt & Suermann (2014) surveyed ASC member schools to discern computer hardware and software traits across construction education providers. They found that over 96 percent of schools utilized Microsoft Excel to teach preliminary planning/cost estimating, based on 56 survey responses (out of 150 ASC member schools). A small percentage of schools utilized On-Screen takeoff (12.5 percent), and Sage Timberline (10.7 percent). Also, Joannides et al. (2012) completed a similar survey and found that 27 percent of construction programs taught Sage Timberline, 23 percent taught using Microsoft Excel, and 19 percent taught using OnScreen takeoff. Additionally, 25 percent of construction schools taught "5D" BIM, where cost is incorporated into the models.

Construction education programs should coordinate their efforts with industry to ensure that requisite coursework is well-defined and meets the specific needs of industry (Badger & Robson, 2000, Ahmed et al., 2014; Ahn et al., 2012; Benhart & Shaurette, 2014). Likewise, construction management faculty should ensure that (1) what they are teaching, and (2) how they are teaching it is pertinent to what a graduate must know and be able to perform once entering the construction industry full time. Hence, understanding what estimating software is most prevalent in industry would be imperative for a faculty member teaching estimating to know to ensure that those software platforms were included in the curriculum. One such data point for construction software utilization is the JB Knowledge annual Construction Technology Report, which is based on an annual construction technology survey. The 2020 report stated that On-Screen Takeoff was the most prevalently utilized takeoff software (43 percent of respondents), followed by Bluebeam (36 percent) and Sage Estimating (11 percent). Additionally, the report stated that Sage Estimating was the most widely used estimating software (19 percent of respondents). It should be noted that only software with a specific construction-related purpose was included in the JB Knowledge survey instrument. Demographics on survey respondents were provided regarding age, gender, title, company size, trade, and general location. No information was provided on sample size.

To summarize, choosing the right software to teach in an estimating course is an important choice for a faculty member to make. This choice should be informed by the needs of industry. Previous research is somewhat dated and has focused more on student perceptions (Eberhardt et al. 2018) and commonalities across construction management programs (Joannides et al. 2012, Engelhardt &

Suermann 2014) as opposed to specific industry feedback on the topic. Furthermore, the results are mixed regarding which software is most prevalently utilized. Lastly, the JB Knowledge annual reports are valuable, but the survey sample size is not clear, and common software such as Microsoft Excel is not even mentioned.

Research Methodology

The purpose of the research was to determine what software applications are most utilized by construction estimators in the United States related to material quantification, and cost estimating. The authors partnered with the American Society of Professional Estimators (ASPE) to conduct this research, as the association has a substantial and experienced membership representing firms across the United States. ASPE is made up of five geographic regions, with over 50 chapters throughout those regions. The exact number of individual members was not provided to the authors by ASPE, but the ASPE website states that the group has over 6,200 members.

The authors first researched all material quantification and cost estimating software platforms on the market. (Note: the specific software platforms are noted in the Results section of this paper.) Next, an initial online survey instrument was developed in Qualtrics by the authors, the contents of which were validated by a group of experienced estimators in the ASPE leadership. The survey included the following questions, along with questions on basic demographic information:

- Q1. What software platform(s) do you typically use to complete quantify takeoff (i.e., the quantification of construction materials)?
- Q2. How often do you utilize BIM models for material quantification? If you use BIM models for material quantification, who develops the BIM models that you use?
- Q3. What software platform(s) do you typically use to create estimates (i.e., determination of project cost based on project quantities, subcontractor quotes, jobsite overhead, corporate overhead, and profit)?

The survey was sent out via email to the ASPE membership once during November of 2019, and twice during December of 2019. Concurrently, the survey was also sent out to members of the McWhorter School of Building Science industry advisory committee. Both surveys were closed in January of 2020.

Results

The authors received 186 complete survey responses, which included 144 ASPE members, and 42 McWhorter School of Building Science industry advisory committee members. The respondents had an average of 28 years of construction industry experience and were in 35 of the 50 states. The respondents average over seven estimates/budgets completed each month with an average cost between \$1 million and \$5 million. Figure 1 provides a breakdown of respondent firm types. As shown, approximately half of the respondents represented general contracting firms, followed by consulting and specialty contractors/subcontracting firms.

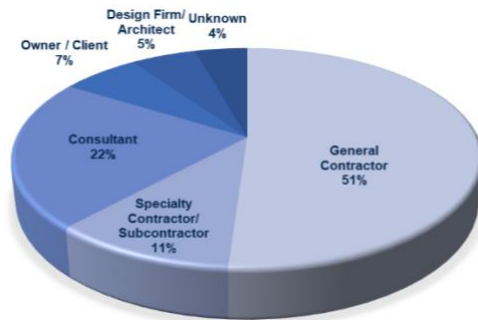


Figure 1. Survey Respondent Firm Type and Prevalence

Q1 - What software platform(s) do you typically use to complete quantify takeoff (i.e., the quantification of construction materials)?

Figure 2 provides a summary of responses regarding what software platforms were most utilized by the respondents for material quantification. As shown, Bluebeam and On-Screen Takeoff were clearly the most utilized. Eight of the respondents (4%) stated that they did not use any software for material quantification.

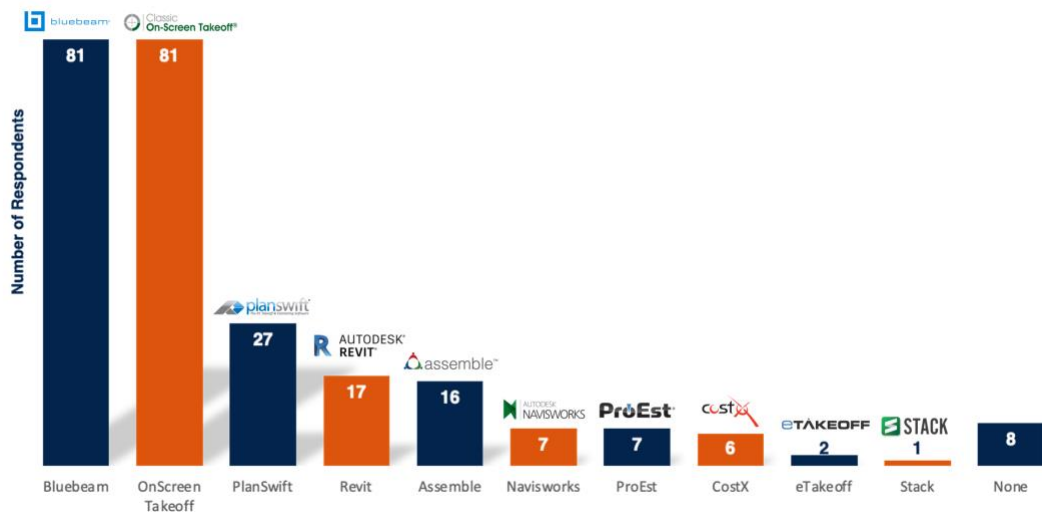


Figure 2. Survey Responses Regarding Software Utilized for Material Quantification

Q2 - How often do you utilize BIM models for material quantification? If you use BIM models for material quantification, who develops the BIM models that you use?

Figure 3 provides a summary of responses regarding how often BIM models are used for material quantification, as well as who typically develops those models. As shown, over 60 percent of respondents never use BIM models for quantification, and approximately 30 percent of respondents sometimes use BIM models for quantification. No respondents always use BIM models for

quantification. A majority of the time (60 percent) the models used for material quantification were developed by the project’s design team, with a smaller percentage of models being developed by either the respondent’s company, their subcontractors or consultants, or themselves.

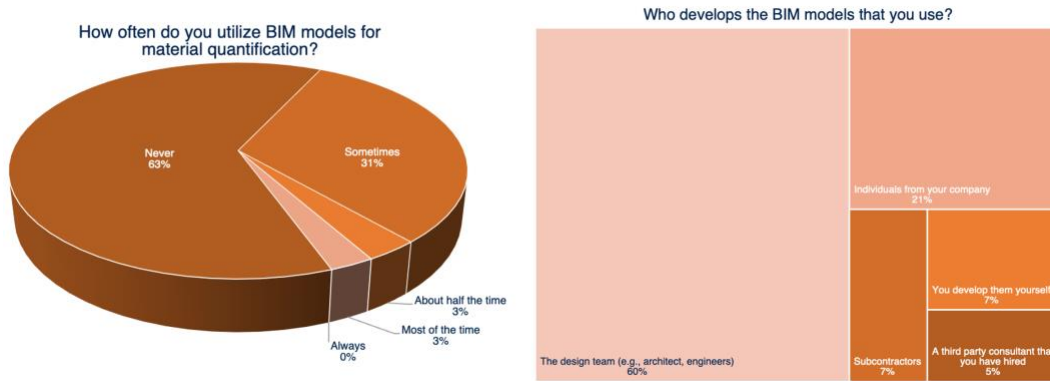


Figure 3. Survey Responses Regarding BIM Usage for Material Quantification

Q3 - What software platform(s) do you typically use to create estimates (i.e., determination of project cost based on project quantities, subcontractor quotes, jobsite overhead, corporate overhead, and profit)?

Figure 4 provides a summary of responses regarding what software platforms were most utilized for creating cost estimates. As shown, Microsoft Excel was clearly the most widely utilized software, followed by Sage Estimating.



Figure 4. Survey Responses Regarding Software Utilized for Creating Cost Estimates

Discussion of Results

The survey results provided valuable information for construction estimating educators that is grounded in the needs of industry. On-Screen Takeoff and Bluebeam were noted by respondents as the most used software for material quantification, as shown in Figure 2. Notably, both software had an equal number of responses. The results do contradict the JB Knowledge 2020 report, which noted that On-Screen Takeoff was more predominant than Bluebeam. Also, this result provides an update to the body of knowledge, where Bluebeam was not mentioned at all in Joannides et al. (2012) or Engelhardt & Suermann (2014).

The author's opinion would be that in the end, an industry professional choosing On-Screen Takeoff over Bluebeam (or vice versa) comes down to personal preference, since both will provide similar results. This provides an opportunity to construction faculty to make a similar decision (i.e., choosing one vs. the other to incorporate into a class) or to teach both software, and highlight the difference for the students. Furthermore, only eight of the 186 respondents (4 percent) stated that they use no software for material quantification. This result provides credence to the fact that a software (no matter what the faculty preference is) should be taught as part of estimating curriculum.

A majority of survey respondents noted that they never use BIM for material quantification, while approximately 1/3 of respondents stated that they sometimes do. These results highlight for estimating faculty that presently model-based material quantification is still in its infancy and should not be taught as a primary method for material quantification at this time, supporting findings described in Elliot et al. (2019). That being said, as is oftentimes stated by a colleague of the authors, there will not be *less* BIM in the construction industry ten years from now. Faculty should incorporate that software which currently meets the needs of industry, while continually seeking to make students aware of what the future needs of industry may be. This sentiment was echoed by the survey respondents, where several provided general commentaries (outside of the specific questions detailed in the results section of this paper) that as they assess new software on the market, BIM material quantification capabilities is a significant factor being considered.

Lastly, 127 of the 186 survey respondents (68 percent) stated that they utilize Microsoft Excel for creating cost estimates, followed by Sage Estimating and a bevy of other software. This result supports the JB Knowledge 2020 annual Technology Report, where Sage Estimating was shown to be the prevailing software for cost estimating. On the other hand, the results clearly show that a non-construction specific software (i.e., Microsoft Excel) is the most widely used. The authors, based on personal experience and anecdotal evidence, feel this result comes from the fact that (1) many longstanding construction firms began developing their own cost estimate templates in the 1980's with the advent of personal computers and do not feel the need to spend the money and effort switching to other software platforms that provides a similar result, and (2) the low cost, prevalence, and ease of use of Microsoft Excel makes it an easy solution for newer and/or smaller contractors to use. Consistent with the finding of Engelhardt & Suermann (2014), estimating faculty should substantially incorporate Microsoft Excel into their curriculum. Other software such as Sage Estimating can be introduced, with the functionality compared to the capabilities of Microsoft Excel.

Conclusions, Limitations, and Future Research

The purpose of the research was to determine what software applications are most utilized by construction estimators in the United States related to material quantification, and cost estimating. Individuals associated with ASPE and the McWhorter School of Building Science industry advisory council were surveyed. The survey findings showed the On-Screen Takeoff and Bluebeam were the most widely utilized software for material quantification, and Microsoft Excel was the most predominant software for cost estimating. Furthermore, most respondents did not use BIM for material quantification but were considering it when assessing new software. The results of the survey were interpreted, and specific recommendations provided involving ways that construction faculty can incorporate software into their estimating curricula.

The results described are limited to the pool of voluntary respondents associated with ASPE and the McWhorter School of Building Science industry advisory council. Similar results may or may not be found if a different sample was used.

Future research should continue to assess the current trends of industry related to estimating software utilization, as new technologies are rapidly entering the marketplace. Furthermore, construction management faculty could be surveyed (as was completed by Joannides et al. (2012) and Engelhardt & Suermann (2014)) to compare industry vs. academia.

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