

# An Analysis of Construction Estimating Software

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There are various components that go into building a construction project. And regardless of the size of the project, construction projects have become increasingly expensive with cost escalations on the rise. The cost element of each construction project is critical to the success of the overall project. In today's current industry, numerous resources are available that strive to assist the built environment with managing construction costs. Currently, construction firms are maintaining a competitive edge by using the technology that has been made available. The basis of this research, conducted using a quantitative survey, was to provide data that indicated which software and techniques construction companies are utilizing. Students in the Construction Management Department at California Polytechnic University of San Luis Obispo (Cal Poly SLO) engage in a range of curriculum objectives. The reassurance that students are well prepared and are being educated using the most updated technologies is paramount to student success at the university as well as after graduation. Overall, this research paper will look at the various estimating and quantity takeoff software that some of the most prominent companies are using. This data will then be used to analyze the estimating curriculum at Cal Poly SLO.

**Keywords:** Construction, Technology, Estimating, Cost, Software

## Introduction

Construction estimating is one of the most time-consuming tasks during the construction planning process. Although this may be true, construction estimating is one of the most crucial aspects of the project and contributes directly to the total cost of the project. Construction estimating is the process of forecasting the anticipated expense of building the structure prior to construction. Before anticipating the expense of the building, a quantity takeoff must be completed. A quantity takeoff for construction refers to the procedure where an estimator reviews the available drawings and measures or counts the physical materials that the architect or engineer specifies to assemble the project. The financial impact to both builders and clients is one of the main uncertainties that comes across a project of any size. It is essential that the preconstruction team devotes a sufficient amount of time and effort to estimating a proposed final cost of the entire project.

In years past, the process of construction estimating, and quantity takeoffs were completed in ways that were very time consuming compared to the time they take to complete today. Quantity takeoffs were done exclusively on printed plans, where takeoff items were measured using a scale and marked-off with colored pencils to indicate that the item was counted. As quantities were taken off, they were immediately noted on a paper spread sheet with extensions and totals calculated manually with a 10-key calculator. As technology has evolved over the last few decades, there has been a significant change in how the construction industry performs construction estimating and quantity surveying. Whether or not a company chooses to make the necessary switch to a more technological approach to estimating, there is now a multitude of options. Programs, applications, and software are available to aid the cost estimator in performing takeoffs and forecasting the total costs.

Regardless of the project type or project size, an accurate cost estimate holds great importance to a construction companies profitability. There is a certain level of accuracy that construction estimates must comply with in order to be feasible for all parties involved. Digital takeoffs can increase efficiency while decreasing the time needed to complete estimating tasks. The indicators of a good cost estimate are one that prevents the builder from losing money and helps bypass the client from overpaying. It is almost impossible to estimate the cost of any project with absolute precision, but a good cost estimator paired with a suitable software can help the process run much smoother. In the construction industry, relationships go a long way and could contribute to repeat clients for contractors, and a good cost estimate can be a primary reason contractors are able to win jobs.

The core philosophy that California Polytechnic University in San Luis Obispo (Cal Poly SLO) was founded on their Learn by Doing methodology. The Construction Management (CM) program which resides under the College of Architecture and Environmental Design provides students with a foundation in architecture, business, and engineering as well as numerous elements in the field. This might include construction methods and materials, the various technologies used to oversee projects, the discrete contracting approaches, the leadership, and teamwork skills demanded by the profession and skills used to manage budgets, schedules, quality, and safety (Cal Poly, 2022). The overall intent of this project is to analyze which estimating and quantity takeoff software systems are being used in industry, based off surveys, and compare this to what is being incorporated in the CM curriculum at Cal Poly San Luis Obispo.

### *Benefit to Construction Management Students and Industry*

This research will benefit the construction management industry because companies will be able to use the surveyed information to determine if they are using the most up to date software available. Companies of various sizes will be able to see what works for other companies which may lead to internal changes within estimating departments. Ultimately, this research can construction management companies shift their current programs to more project efficient estimating programs. A major goal of the estimating curriculum within the construction management department is for students to become familiar with software that will be used in their future careers.

## **Literature Review**

Over the past few decades' technology has evolved significantly and has provided a clear path to a more efficient way of delivering projects on time, under budget, and at a certain level of quality. However, the construction industry is notorious for not taking advantage of the available technologies to improve construction projects. Delivering construction projects under budget could be one of the most crucial aspects of the project for all parties involved. The construction industry has been known to be a sector that adopts new technologies at a very slow rate. The construction industry still spends about 80% less of their revenues on information technology when compared to other industries (Richer, 2021). This is unfortunate for the industry because there is an abundance of resources that could be adopted in order to help deliver projects under budget. There are various reasons why the construction industry may be slow to adopting new technologies including trust in the accuracy of various software, technology learning curves, and additional costs for estimating programs.

One of the reasons behind the slow adoption of technology in the construction industry is the level of trust in the accuracy that the software provides. Industries, such as construction, rely heavily on the certainty that the software will provide accurate results throughout the duration of the project. Changes occur throughout the project, and it is important that the software will be able to capture all these changes. In addition, it is crucial that estimators can see clear results from using the software, so the company knows they are paying for a program that will put them ahead in an already competitive market. A survey, conducted by Gallis et al, was completed showing random projects completed in a region of Norway. Data was collected using 44 out of the 52 projects surveyed. The other projects were discarded because they involved fewer than 100 manhours, or most estimation and development work had been done by outside consultants, or the project managers had not kept accurate track of estimated and/or actual costs. According to the research done, out of 42 projects that were completed, 32 (76%) had cost overruns, two projects (5%) ended up on target, and eight projects (9%) came in under the budgeted cost (Gallis et al, n.d). Each of these projects were completed using a construction estimating software yet a majority of the projects still came in over budget. The fear of purchasing an expensive license for a software while simultaneously projects are still coming in over budget could be a big factor in why construction contractors are slow to adopting new technologies.

Learning curves can quickly derail the perspective an estimator has on various technological programs. Transferring knowledge and training individuals in a new program could be very time consuming to companies, especially if they are a small company who may not be able provide this extra time. In addition, adopting new technology platforms could be disruptive to the current company workflow. Studies show that estimators require one to two months of training with BIM software before the company will save time and costs on a project (Sattineni & Bradford, n.d.). Small companies are at the most risk when it comes to being left behind by industry leaders. According to research, companies are the only credible focus for change in the construction industry. Companies, of every size, must be motivated to move towards the adoption and use of new technologies (Aouad et al, 2011). Investing time into employee training throughout the year will make changes in the future less of a problem and team members will be more open-minded to any adjustments.

Various forms of technology are constantly being rolled out to help companies produce results as efficiently as possible. But with the addition of these programs comes an additional cost. Especially since technology is always evolving, it could be difficult for construction firms to constantly upgrade their software to the next best one. Many estimation models have been proposed over the last 30 years (Leung & Fan, n.d.). Companies may feel inclined to not take on any additional costs by not implementing any new technology for a projects estimating or cost controls. It is essential that construction firms are looking at the big picture and not holding any biases toward estimating programs. Mentioned in research by Sattineni and Bradford, construction firms should be viewing estimating software as an investment to their company. Some time and money will have to be spent upfront but greater cost and time savings will be seen in the future (Sattineni & Bradford, n.d.). Information technology awareness should be created and directed toward organizations within the built environment to inform and better integrate construction project contributors (Koekemoer & Smallwood, 2007). The presence of information technology is strong and will continue to weigh heavy in the construction industry. Based on all these factors of previous research, this research will focus primarily on estimating systems that are currently being used in industry.

## **Methodology**

The methodology chosen for this analysis was a quantitative survey to gather the necessary data to discover the programs companies are using. In addition to this, the survey will also uncover any speculation as to whether students at Cal Poly San Luis Obispo are learning the most prevalent software that is used in the built environment. This hypothesis will be tested by measuring variables and analyzing results with statistical procedures. From a fieldwork research approach, a postal questionnaire will be the most suitable for this project. In this case, a survey was conducted using Google Forms. The survey was sent out to Cal Poly's list of Construction Management Advisory Council (CMAC) members as well as Construction Management Alumni who are all active in the construction industry. The survey was focused on general contractors, subcontractors, and construction management firms.

The survey consisted of 7 questions (see Appendix A) which will provide the necessary information to analyze results and give insight to the initial hypothesis. Size of the company was determined based on earned revenue. Any company making less than \$5 million was a small company, between \$5 - \$15 million was a medium company, and any revenue more than \$15 million was considered to be a large company. Participating construction firms were asked which software they used for quantity takeoffs and what software they used for construction estimating. Immediately after these questions was another two questions regarding how long the company had been using such software for each of the above tasks (estimating and quantity takeoffs). The survey questions were written to be as straightforward as possible while at the same time giving participants room to provide their own feedback. Leaving "other" as an option on a few of the questions was intentional. If the options given were not applicable to such company, the firms had the ability to insert their own answers to the questions asked. Each survey question was carefully analyzed, and results were used to capture the true outcome of construction estimating and construction takeoff programs.

## **Results**

The survey sent out for this project accumulated a total of 59 responses from a variety of companies. The first question that was asked in this survey was for the respondent to insert the name of the company that they were filling out the survey on behalf of. This will not be shown in the results simply for privacy reasons. The types of companies that were surveyed consisted of general contractors (68%), specialty contractors (22%), general contractors who also self-perform their work (8%), and an engineering consultant (1.7%). The graphical results for this question can be found in *Figure 1* below. The next question in the survey was intended to capture the size of the companies. But rather than surveying based on number of individuals within a company, the firm size was based on revenue. The options that were given were: below \$5 million (3.4%), between \$5 - \$15 million (0%), and over \$15 million (96.6%). The graphical result for this question is shown below in *Figure 2*.

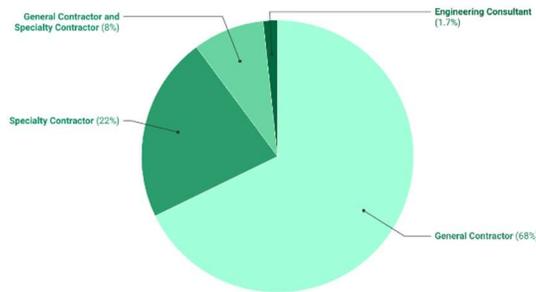


Figure 1. Types of Companies Surveyed

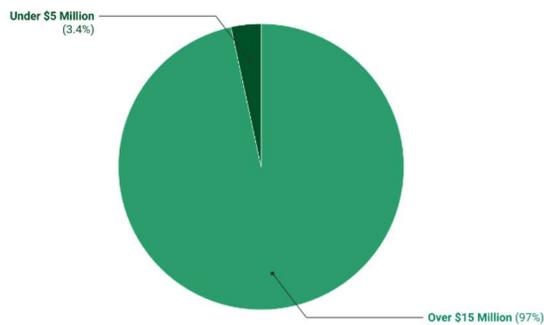


Figure 2. Size of Company based on Revenue

The purpose of the next set of questions was to identify what software each company was using for their quantity takeoffs and what programs they were using for the actual number crunching for estimation purposes. Technology is always changing and adapting so it was also important to know how long each company had been using the software that was indicated. The results for quantity takeoff software used are as follows: On-Screen Takeoff (39%), Bluebeam (22%), Combination (15%), Model Based (8%), By Hand (7%), Plan Swift (7%), and Construct Connect (1.7%). The graphical evidence for this is shown below in *Figure 3*. Results indicated that 83% of companies have used the indicated software for more than 4 years, 8% have been using the software for 3-4 years, 7% for 1-2 years, and 1.7% for less than a year. The statistics for this are shown below in *Figure 4*.

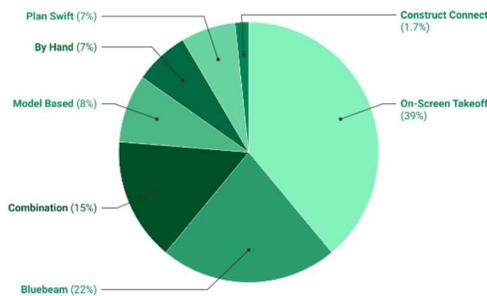


Figure 3. Quantity Takeoff Software

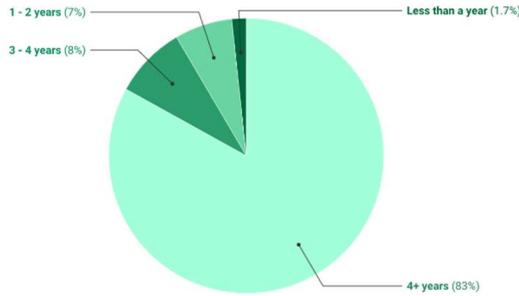


Figure 4. Time dedicated to selected Quantity Takeoff Software

The remaining two questions embedded in the survey were to disclose the type of software that companies had adopted to perform their actual construction estimating tasks. Quantity takeoffs and construction estimating are two very different processes which is why these questions were separated. The results for the last two questions are as follows: Excel (39%), WinEst (19%), On-Screen Takeoff (14%), Sage (8%), Vico (8%), HeavyBid (5%), Destini (3.4%), Construct Connect (1.7%), and QuickBid (1.7%). These results are shown in *Figure 5*. These results also indicated that 93% of companies have used their software for more than 4 years, 3.4% have been using the software for 3-4 years, 1.7% for 1-2 years, and 1.7% for less than a year. The graphical representation of these results is shown in *Figure 6*.

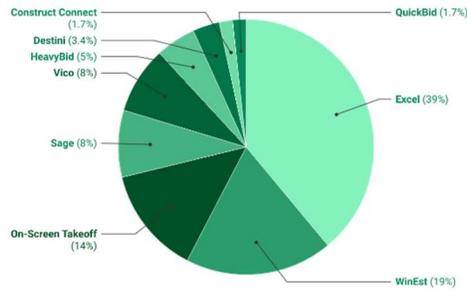


Figure 5. Estimating Software

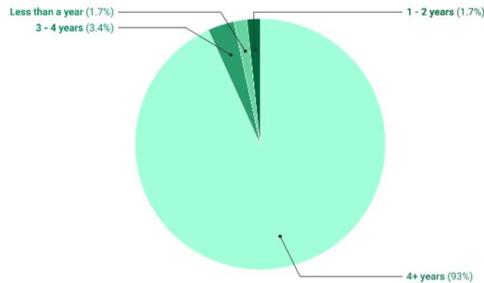


Figure 6. Time dedicated to selected Estimating Software

## **Discussion**

After analyzing the data from the survey conducted there was a variety of findings that could be pulled from the results. It was evident that a majority of the participants were general contracting companies who have over \$15 million in revenue. When a company has indications of high revenue, an assumption could be made that the company will have the resources to provide their cost estimators or cost managers with the appropriate software to be as productive as possible.

The quantity takeoff software that was used the most by the surveyed companies was On-Screen Takeoff (OST). This result was not very surprising. The gathered data also showed that 83% of the companies had been using this software for more than 4 years. This information demonstrates that OST has been a significant software used by many of the leading construction companies for quite a while now. The second most popular quantity takeoff software that is being used is Bluebeam.

When discussing construction estimating, a majority of the company surveys indicated that they used Microsoft Excel. It was also stated that 93% of the companies had been using this software for more than 4 years. These results were also not too surprising. Microsoft Excel, in itself, can be very powerful for any industry. This software is easily compatible with other programs, and it is also easy for estimators to share information with other project team members. Through different courses in the Construction Management Department, Excel is used heavily to create worksheets that show the various cost elements for projects that students are working on throughout the quarter. Like stated previously, almost every industry utilizes Microsoft Excel in some shape or form so it is vital for students, regardless of major, to understand and be completely familiar with Excel. Evidently, from the results of the data there are a variety of estimating programs that construction firms can use. It is important to acknowledge that the software students are being taught considerably correlates with what many of the construction industry leaders are practicing.

## **Conclusion and Future Work**

Members of the construction industry can translate the data gathered to try and understand whether they need to make any adjustments regarding the construction software they are utilizing. Companies are able to see firsthand where they stand in comparison to companies of similar nature. In addition to this, professors at Cal Poly San Luis Obispo can measure what they are incorporating into their curriculum and compare that with what interns and graduates will be faced with in the real construction world. From the results of the survey, it is a good sign that Bluebeam is one of the top systems used in industry. Most students in the Construction Management Department, if not all, are very familiar with how to maneuver around Bluebeam to perform various material takeoffs. Unfortunately, the exposure to OST has not come from the Construction Management Department. Instead, experience in this software has solely come from internships held over various summers. There are many opportunities for students to continue this type of research. With the rate that technology is advancing, the software that is currently being used may very well become outdated. A similar survey could be conducted again in 2026, four years in the future, to see where companies are standing at that time. Future students and researchers could also begin to look at other aspects of companies, such as location or years in business in the built environment. In many cases during this survey, companies indicated that they used a combination of software. A future student can prepare another in depth analysis as to why companies are choosing one software over another for their projects. Staying up to date with evolving construction technology in the classroom will provide students with more advantages during their time at Cal Poly and upon graduation.

## References

- Aouad, G., Barret, P., & Sexton, M. "Motivating Small Construction Companies to Adopt New Technology." *Building Research and Information*, 08 Feb. 2011, <https://www.tandfonline.com/doi/pdf/10.1080/09613210500254474?needAccess=true>.
- Bradford, R., & Sattineni, A. "Estimating with BIM: A Survey of U.S. Construction Companies." *Auburn University*, N.d., [https://www.researchgate.net/profile/Anoop-Sattineni/publication/320405367\\_Estimating\\_with\\_BIM\\_A\\_Survey\\_of\\_US\\_Construction\\_Companies/links/5b15406baca2723d9981fafc/Estimating-with-BIM-A-Survey-of-US-Construction-Companies.pdf](https://www.researchgate.net/profile/Anoop-Sattineni/publication/320405367_Estimating_with_BIM_A_Survey_of_US_Construction_Companies/links/5b15406baca2723d9981fafc/Estimating-with-BIM-A-Survey-of-US-Construction-Companies.pdf).
- "Construction Estimating 101: Everything You Need to Know." *Construction Software*, 20 Sept. 2019, <https://esub.com/blog/construction-estimating-101-everything-you-need-to-know/>.
- "Construction Management." *Cal Poly*, N.d., <https://www.calpoly.edu/major/construction-management>.
- Fan, Z. & Leung, H. "Software Cost Estimation." *World Scientific*, N.d., [https://www.worldscientific.com/doi/abs/10.1142/9789812389701\\_0014](https://www.worldscientific.com/doi/abs/10.1142/9789812389701_0014).
- Gallis, H., Hove, S., Jorgensen, M., Lien, A., Ostvold, K., & Tanilkan, S. "A Survey on Software Estimation in the Norwegian Industry." *Simula Research Laboratory*, N.d., <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.483.702&rep=rep1&type=pdf>.
- Gerardi, Jeff. "What is quantity takeoff in construction?" *ProEst*, 29 Aug. 2021, <https://proest.com/construction/takeoffs/quantity-takeoff/>.
- "Learn by Doing." *Cal Poly*, N.d., <https://www.calpoly.edu/learn-by-doing>
- Ramos, Diana. "Construction Cost Estimating: The Basics and Beyond." *SmartSheet*, 26 May 2017, <https://www.smartsheet.com/construction-cost-estimating#:~:text=Construction%20cost%20estimating%20is%20the,failing%20to%20complete%20a%20project>.
- Richer, Michael. "Why Contractors are Slower to Adopt New Technologies." *Construction Executive*, 14 Dec. 2021, <https://www.constructionexec.com/article/why-contractors-are-slower-to-adopt-new-technology-and-why-they-shouldn't-be#:~:text=Why%20Are%20Contractors%20Slower%20to,been%20developed%20in%20recent%20years>.
- Koekemoer, V. & Smallwood, J. "Information Technology (IT) in the Construction Process." *ResearchGate*, Jan. 2007, [https://www.researchgate.net/publication/267957095\\_Information\\_Technology\\_IT\\_in\\_the\\_construction\\_process](https://www.researchgate.net/publication/267957095_Information_Technology_IT_in_the_construction_process).

Williams, Ed. "Why spend time on Estimates?" *Contractor*, 15 Nov. 2021, <https://www.contractor-mag.com/management/project-management/article/21181296/why-spend-time-on-estimates>.

## Appendix A – Survey Questions

1. What company do you work for?  
Fill in Answer \_\_\_\_\_
2. Which of these companies does your company fall under?
  - A. General Contractor
  - B. Subcontractor
  - C. Other \_\_\_\_\_
3. Which of the following describes your company based on revenue?
  - A. Under \$5 Million
  - B. Between \$5 - \$15 Million
  - C. \$15+ Million
4. Which of the following describes how your company performs quantity takeoffs?
  - A. By Hand
  - B. Bluebeam
  - C. Construct Connect
  - D. On-Screen Takeoff
  - E. Model Based (such as Assemble or Tekla)
  - F. Plan Swift
  - G. Other \_\_\_\_\_
5. How long has your company been using the selected method/software to perform quantity takeoffs?
  - A. Less than a year
  - B. 1 – 2 years
  - C. 3 – 4 years
  - D. 4+ years

6. Which of the following describes how your company performs construction estimating?

- A. By Hand
- B. Excel
- C. On-Screen Takeoff
- D. Construct Connect
- E. Plan Swift
- F. Other \_\_\_\_\_

7. How long has your company been using the selected method/software to perform construction estimating?

- A. Less than a year
- B. 1 – 2 years
- C. 3 – 4 years
- D. 4+ years