Construction Software: Use, Selection, and Performance in Low-Bid Contracting

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The qualitative research included in this study evaluates the use, selection, and perceived gaps of current construction software suites in low-bid contracting. In addition, the data aims to provide merit to the correlation between construction software use and company performance. The intended stakeholders of this study include entrepreneurs in software development and construction, along with researchers looking to gather knowledge pertaining to this niche industry. Through a Google Forms questionnaire distributed via email, participants provide insight on the current status quo. The study’s responses show clear trends in the types of software currently in use and the subsequent reasons for selection. The software categories analyzed included takeoffs, scheduling, estimating, and document management. Concluding data reveals that the most popular software platforms are Bluebeam, Primavera 6, Heavy Bid, and cloud-based folders for their respective categories. Moreover, the most desirable software traits are found to be advanced functionality, user friendliness, and familiarity. While the perceived gaps in current technology include an equal split between user friendliness, full-service offerings, and no gaps. This data provides insights into the software preferences and practices of low-bid contractors. It also confirmed that there is a correlation between the amount of software used and company performance.

Key Words: Low-bid, Construction, Software Selection, Company Performance, Technology

Introduction

This research-based study evaluates the intricacies of low-bid contractor’s software use. The objective of this research is to reveal what software suites are in use, the reasons for using a given software, perceived gaps in functionality, and analyzing if there is a correlation between software use and company performance. The focus on low-bid contracting is to achieve an accurate consensus within a specific construction delivery method. A broad-based questionnaire geared toward all delivery methods: low-bid, design-build, IPD, etc. would likely return unusable data. Therefore, the companies evaluated in this study primarily perform low-bid, Design-Bid-Build, work. This data can be used to identify the status quo of the low-bid industry and reveal areas of improvement. The target audience for this report is individuals or companies looking to break into the low-bid construction market. Additionally, this report reveals objective data that researchers can use to better understand the current environment and needs of the industry.

Literature Review

A broad trend in the construction industry is digitizing elements of the construction process to create efficiencies in companies’ production (Chen, 2021). Beginning in preconstruction and running throughout the close of a project, many deliverables can be enhanced using construction software. Within low-bid contracting, tasks such as communication, quantity takeoffs, modeling, estimating, budgeting, scheduling, and project management have an array of software offerings available. These software suites are covered by 3 general categories. A recent study identifies these categories as: estimating, project management, and document management (Mohd, 2014). Each offering aims to
automate and or augment the construction process. Empirical differences in features, usability, and price points create a market for each individual software offering. It is imperative to understand what software currently exists, the areas of improvement, and software’s relation to company performance. Understanding these concepts reveals the status quo and future of software in low-bid contracting.

**Estimating Software**

Estimating software is one of the many tools available for use during the construction process. This software allows companies to estimate projects in an efficient manner. This is important to low-bid contractors because on average construction companies win 1:10 public project they bid (Alkhateeb, 2021). Through different software suites tasks such as quantity takeoffs, estimates, and budgets can be digitized. When evaluating software available for quantity takeoffs the most popular platforms are Plan Swift, Bluebeam, ProEst, and Square Takeoff (Williams, 2024). Each software has unique features, but they broadly support interaction with digital plan sets, scaled measurements, and quantity counts. These features organize and quantify data allowing users to break down a project more efficiently when compared to the pen and paper method. Once the quantity takeoff is complete the next step in the estimating process is to create a cost estimate and budget. When creating cost estimates and the subsequent budget there are many platforms that offer users the functionality of labor and equipment production rates, fuel costs, and material prices. Additionally, historical project data can be uploaded and reused in new estimates. The most popular construction software for cost estimating varies. However, data from a recent case study of 59 participants found Excel, WinEst, and On-screen takeoff to be the most popular platforms (Lozano, 2022). The rationale behind each software choice was not provided, which is information this case study intends to convey.

**Project Management**

Project management software is another overarching category of available software suites used by low-bid contractors. This software is leveraged to plan and track the construction process. In the United States, public works low-bid contractors are often required to submit a construction schedule and update them periodically. In addition, companies use these schedules internally to manage the allocation of labor and equipment between jobs. The data on the most popular scheduling or project management software differs from region to region. However, focusing on the United States Microsoft Project (MP) and Primavera (P6) have most of the market share (Mladen, 2012). This coincides with the public works requirement which often provides MS project and P6 as acceptable management software. Adopting this software creates an organized and accessible plan for a given construction project. The value derived from these applications includes identifying resource constraints and conflict. Choosing what suite is best for a particular user is ambiguous. Additionally, there is little available data on why companies choose a given software. This is another question that will be addressed within this study.

**Document Management**

Managing construction project documents is another task software aims to make more efficient. Document management systems (DMS) are programmed to communicate, organize, and store project compliance and progression documents. Use cases of these products are broad, however, users can expect to track financials, schedules, requests for information (RFI), and field reports. There is a large market for these products because successful management of construction projects require effective information management (Egan, 1998). These DMS all provide similar functions. However, some platforms focus on niche markets while others provide a holistic approach to project organization. For example, there are DMS that solely track contractor or subcontractor insurance forms. Other platforms
cover all project documentation with more broad-based organization measures. Popular document management programs include Procore, Aconex, Build Tools Construction, IPM Project Management, and HD Project Cost Management (Reddy, 2015).

Gaps in Software Functionality

Within the realm of construction software there are inevitable gaps in functionality, both perceived and apparent. This distinction stems from user ignorance versus real functionality gaps that are not currently offered. Construction companies must balance a line of usability and functionality, which is often a sliding scale that is determined by the amount of training each employee gets. Current research of objective evaluations of construction software suites is minimal. Presumably, this is because each employee has subjective experience with any given software. However, a recent study identifying the development of information exchange platforms for contractors found users commonly cite a “reduced learning curve”, “enhanced affordability”, and “consistent user experience across devices” as an area where software can improve (Agrawal, 2023 pg 48). Therefore, based off the current data available, it can be inferred that the perceived gaps in technology stem from a lack of training, both from construction companies and software platforms. While the empirical gaps in construction software are cost of entry and compatibility with people of all skill sets.

Performance

Digital software has become increasingly popular in the construction industry starting around the year 2000 (Chen, 2021). Construction management software makes processes more fluid and improves project operations (Demski, 2021). These internal improvements create efficiencies that can be seen in a company’s financial health and performance. A recent interview with a small residential construction company explained that implementing both document and project management software improved recordkeeping efficiency and dispute resolutions (Martin, 2020). Although this is not a financial performance metric, the efficiencies technology bolsters can be leveraged to improve employee productivity. As studies have found, “a company’s financial performance is correlated to its quality and productivity” (Lee, 2001).

Methodology

The qualitative research within this project was achieved through the strategic use of a Google Forms questionnaire distributed through email (See Appendix A). This data collection method was chosen because it offered the ability to request qualitative responses while keeping the questionnaire simple. The beginning of this survey prompts participants to provide their company name, not to be shared, and confirmation that the contractor performs low-bid work. The next section contains the main questions in the survey. They ask what software the companies use when conducting takeoffs, scheduling, estimating, and document management respectively. These questions are formatted such that participants can choose from a list of common software or add their own. Following these initial questions, an open ended follow up question aims to identify why the participant uses a given software. These follow up questions are formatted, as select all that apply, each with identical options: familiarity, advanced functionalities, collaboration, user friendliness, and a section for other responses. The final question pertaining directly to construction software asks what is missing in current construction software offerings. This question is formatted, as a select all that apply, with options including all-inclusive software offering, training, user friendliness, collaboration, nothing missing, and a section for other responses. The closing questions on the survey ask about the company’s yearly revenue and number of employees. These questions were marked optional and separated into two questions. The intention was not to deter contractors from completing the survey.
Companies tend to balk at giving out financial performance metrics, so structuring the question in this way eases companies into responding. To select eligible participants to contact, California Polytechnic State University’s Construction Management recruiters list was leveraged to identify low-bid contractors. Then a phone call to the company office was made to obtain an email of a qualified employee to fill out the questionnaire. After obtaining the correct emails, a brief description of the project followed by the google forms link was sent out. No further follow-up was needed to get the necessary responses from the companies.

Results

Software Use and Selection

The research questionnaire received 9 responses from low-bid contractors primarily located in the Western United States. The results confirmed some of the existing data while producing new insight on lesser researched topics. There are clear trends apparent in the study’s data. Beginning with figures 1-2, the data shows that Bluebeam is the takeoff software of choice with 55% of the total responses. The industry reasoning behind the selection of takeoff software included advanced functionality and familiarity. Figures 3-4 confirmed the 2012 study referenced in the literature review above. The data shows that P6 and MP are the most common scheduling software. Reasons for using the select scheduling software included advanced functionalities and user friendliness. Figures 5-6 revealed that Heavy Bid was the most used estimating software mentioned in 77% of participants’ responses. While the only other estimating software in use was Ineigh Estimating. The reasons companies chose to use this software included advanced functionality and user friendliness. Figures 7-8 were also concentrated, with only two different document management selections. The majority of companies, totaling 66%, used cloud-based file sharing options. The rest of the companies used hard copy project folders to manage project documents. Finally, the perceived gaps in technology, Figure 9, were equally split between user friendliness, complete full-service offerings, and no gaps. All responses have been compiled into graphical data listed below:

Figure 1. Takeoff software used by low-bid contractors
Figure 2. Why the given takeoff software is used

Figure 3. Scheduling software used by low-bid contractors

Figure 4. Why the given scheduling software is used
Figure 5. Estimating software used by low-bid contractors

Figure 6. Why the given estimating software is used

Figure 7. Document management software used by low-bid contractors
After analyzing all responses to the survey, software is used in all parts of the construction process, with an exception being document management. Of the response received, 33% of companies used hard copy binders to keep track of project documents. Therefore, to test if the use of software is correlated to company performance, figure 10 conveys revenue, employee count, and revenue per employee categorized by software type. The result indicates that contractors using DMS have a much higher average revenue and employee count. In addition, the same companies are 21 percent more efficient based off the revenue per employee metric.
The findings from this study provide insight into the software preferences and practices within low-bid contracting. The results indicate clear trends in software selection across various categories, including estimating, scheduling, and document management. Bluebeam emerged as the preferred choice for takeoff software, while P6 and MP were the most popular scheduling software. Additionally, Heavy Bid stood out as the most utilized estimating software, and cloud-based file sharing options were the predominant choice for document management. While the reasons for software selection varied, responses often included factors such as advanced functionality, user friendliness, and familiarity. These findings underscore the importance of understanding user needs and preferences when designing and implementing construction software solutions. Moreover, the study showed that perceived gaps in technology included user friendliness and full-service offerings. These insights highlight areas for improvement within the current landscape of construction software. This study has also showed that the current software suites available can be leveraged to support higher revenue, employee, and revenue per employee counts.

Future Research

Future research should be conducted to solidify the conclusions above. As mentioned, the participants in this case study were from the Western Region of the United States which introduces inherent geographical bias. Additionally, the questionnaire itself could be improved by allowing contractors more flexibility in answering. This survey only allowed a single software choice per software type. The data may have shown different trends if multiple selections were allowed. Another idea for further research could be a quantitative approach to this study. By creating a similar questionnaire and distributing it abroad, a more complete analysis can be conducted. A final note worth mentioning is that “software use and selection” could have been its own separate project from the “correlation of software use to company performance”. However, this study is able give a holistic view of low-bid contracting in regards to construction software.
References

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Appendix A – Questionnaire
1. Please provide your company name, (This will not be disclosed) *

2. Please confirm your company conducts low-bid work. *

   Mark only one oval.
   - Yes
   - No

3. What software does your company use to complete takeoffs? *

   Mark only one oval.
   - Bluebeam
   - Plan Swift
   - Square Takeoff
   - Pen and Paper
   - Other:

4. Why do you choose this software for takeoffs? *

   Check all that apply.
   - Familiarity
   - Advanced Functionalties
   - Collaboration
   - User Friendly
   - Other:

5. What software does your company use to complete schedules. *

   Mark only one oval.
   - Primavera (P6)
   - Microsoft Project
   - Excel
   - No Digital Schedule
   - Other:

6. Why do you choose this software for scheduling? *

   Check all that apply.
   - Familiarity
   - Advanced Functionalties
   - Collaboration
   - User Friendly
   - Other:

7. What software does your company use to complete estimates? *

   Mark only one oval.
   - Heavy Bid
   - Inreht Estimating (Hard Dollar)
   - Excel
   - WinEst
   - Other:
8. Why do you choose this software for estimates? *
   
   Check all that apply:
   □ Familiarity
   □ Advanced Functionalities
   □ Collaboration
   □ User Friendly
   □ Other:

9. What software does your company use to manage project documents? *
   
   Mark only one oval.
   □ Procore
   □ BuildTools
   □ Cloud Based Folders
   □ Hard Copy Folders
   □ Other:

10. Why do you choose this software to manage project documents? *
    
    Check all that apply:
    □ Familiarity
    □ Advanced Functionalities
    □ Collaboration
    □ User Friendly
    □ Other:

11. What functionalities are missing from current construction software? *
    
    Check all that apply:
    □ Full Service (All-inclusive Software Offering)
    □ Training
    □ User Friendly
    □ Collaboration
    □ Nothing Missing
    □ Other:

12. What is your company's approximate yearly revenue?

13. Approximately, how many employees does your company have?