Adoption of Artificial Intelligence in Quantity Takeoffs in Engineering & Construction Organizations

Key Points

- Artificial Intelligence (AI) represents unlimited potential within the E&C industry.
- AI in quantity takeoff applications is an emerging application that helps improve estimator productivity and accuracy.
- Reengineering quantity takeoff and estimating workflow is the most effective approach to incorporating AI in the process.

Introduction

Originally, quantity takeoffs (QT) and estimating were done with blueprints, a ruler, a pencil, highlight pens, and a calculator. Takeoffs and estimates for any given project took days, if not weeks, to complete. Then, in the 1990's and 2000s, construction companies began using technology and software to digitalize their takeoff process, but it still required hours/days/ weeks, of clicking, counting, coloring, and manual calculations. With the technology available to us today, this old way of doing business no longer makes sense.

This executive insight focuses on organizational and management considerations that E&C organizations should weigh as they consider digitizing QT operations by deploying artificial intelligence (AI) software. The advent of AI allows us to train our software to execute repeatable tasks like measuring, counting, coloring, naming, and analyzing documents with record speed and accuracy. AI enhanced QT software enables estimators to now execute a takeoff in seconds with +98% accuracy saving an untold amount of dollars and hours.

Technical Development Process

Starting from the premise that AI does well with repeatable tasks, the software development typically focuses on incorporating repeatable tasks that can help alleviate the estimator's pain points of spending hours doing mundane clicking, counting and coloring. The software developers concentrate on factors including the big costs; task repetitiveness; and data input source (blueprints, pictures, voice). Deep machine learning is used to analyze construction plans, then tasks are executed/performed based on what the estimator needs.

The takeoff process is reduced to solving several AI problems including the machine learning tasks of semantic segmentation, object detection and image classification. These models are custom trained, and the model architecture is constantly adjusted to current requirements and inference limitations. Once trained, these models are deployed to the cloud for processing construction drawings. The machine learning models are trained using custom annotated floorplan datasets that allow the system to identify walls, their types, rooms, and their types as well as detect objects on floor plans. Large language models are used to allow the retrieval of valuable information from the text extracted from the floorplans. The user interacts with the AI layer through a functional web-based takeoff interface which also allows manual takeoff.

The AI estimating software saves time not just because of the use of AI, but also because the entire takeoff workflow has been reengineered. Time savings are realized starting with the fact that the AI QT software is typically cloud based and requires no downloads and installation to the user's workstation. The AI QT software also automatically labels and sorts the project plans, historically, a manual process that took hours and a dedicated full-time person who built and managed plan logs.

The output is usually simplified with a built-in *smart* spreadsheet that can be exported or mapped to specific customer spreadsheets. Collaborative features typically eliminate the emailing of massive files by simply sharing a link within an organization or with subcontractors allowing seamless access and allowing the Preconstruction manager to control access by assigning permissions giving users various capabilities.

Available Features in Selected Quantity Takeoff/Estimating Software

Table 1 shows a list of features tracked across the four software platforms of Togal.ai, BlueBeam, OnScreen, and PlanSwift. Togal.ai is the only software listed that uses an AI engine to determine spaces, areas, and distances automatically to implement the quantity takeoff process. A detailed comparison of the typical features in Table 1 shows that:

- **Togal** claims to use AI to execute quantity takeoff tasks with a 98% or better accuracy rating (i.e., better than human error). Togal has been in the market for over 3 years (https://togal.ai).
- **BlueBeam** claims to improve quantity takeoff and estimation accuracy with its intuitive, customizable PDF markup and measurement tools (https://bluebeam.com).
- **PlanSwift** is a cloud-based takeoff and estimating software that claims to create accurate and fast quantity takeoffs for construction projects (https://www.planswift.com/estimating-software/).
- **OnScreen** is a cloud-based takeoff and estimating software that claims to be the unparalleled industry standard (https://www.oncenter.com/products/on-screen-takeoff/).

Table 1. Feature comparison of quantity takeoff/estimating software (Adapted from togal.ai)

Feature	Togal	BlueBeam	OnScreen	PlanSwift
AI & Search				
AI Image Search	✓	☐	☐	☐
Text Search	✓	✓	☐	☐
Togal GPT	✓	☐	☐	☐
Functionality				
Cloud-based	✓	☐	☐	☐
Curve Takeoff on Linears (Arc Line)	✓	✓	☐	✓
Split Tool	✓	☐	☐	☐
Merge Tool	✓	☐	☐	✓
Real-time Internal Collaboration	✓	☐	☐	☐
Real-time External Collaboration	✓	☐	☐	☐
User Permissioning / Management	✓	☐	☐	☐
Export Filtering	✓	✓	☐	✓
Drawing Revision Management	✓	☐	☐	☐
Auto Drawing Naming	✓	✓	☐	☐
Floorplan AI Area Takeoff	✓	☐	☐	☐
Floorplan AI Linear Takeoffs	✓	☐	☐	☐
Floorplan AI Count Takeoffs	✓	☐	☐	☐
Snapping To Points	✓	✓	☐	✓
Organization Library	✓	☐	☐	☐
Personal Library	✓	☐	☐	✓
Auto Scale Detection	✓	☐	☐	☐
Export Multiplier (typ. floor/building/etc.)	✓	☐	☐	☐
Drawing Overlay	✓	✓	✓	✓
Cut	✓	✓	✓	✓
Smart Fill of Cut Area	✓	☐	✓	☐
Smart Copy Paste	✓	☐	✓	☐
Markup Tools	✓	✓	✓	✓
Area Breakdown	✓	☐	✓	☐
Export Grouping	✓	✓	✓	✓
Metric	✓	✓	✓	✓
Imperial	✓	✓	✓	✓
Metric and Imperial in same project	✓	☐	☐	☐

Future Developments

The same AI engine used in the quantity takeoff process to determine spaces, areas, and distances automatically, can be extended to analyze building designs and automatically check them against applicable building codes. What once took hours of manual checking, cross-referencing codes, and back-

and-forth discussions with regulators can now be completed in a fraction of the time. The most common and most time-consuming tasks including egress, capacity, dead end, travel path, and wheelchair turnaround can efficiently be checked by government agencies, architects, engineers, contractors and owners (AECO) using the AI engine extension.

Automated code checks mean architects can focus on what they do best—designing—and let AI handle the complexities of code compliance. This efficiency is particularly important in fast-paced industries like commercial and residential development, where delays can lead to financial losses. By using AI to reduce the time and effort it takes to ensure code compliance, the entire design-to-construction process is accelerated, enabling architects, code consultants, Authorities Having Jurisdiction (AHJs) and contractors to streamline the process and improve accuracy.

Bottom line: AI technologies can reduce errors, improve efficiency, and provide real-time project updates. for construction estimating.

About the Authors

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