

## **ELECTRONIC DOCUMENTS: SAVING CONTRACTORS TIME AND MONEY**

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### **ABSTRACT**

This paper reports the findings of research that was conducted to evaluate whether or not takeoff viewers are developed to the point where takeoffs can be completely performed without paper documents. The findings show that software is developed enough that complete takeoffs can be performed without having the paper documents. The report identifies the features required to perform a takeoff rather than recommending one software package over another. The software features are evaluated based upon whether the features are basic requirements or advanced features. The research also included different monitor configurations and made recommendations on monitor size and screen resolution settings.

### **KEYWORDS**

Estimating, Electronic Documents, Takeoff Viewers

### **1. INTRODUCTION**

Electronic documents are becoming more widely distributed by designers of construction projects. A factor behind the increased distribution of electronic documents is the cost savings to the designers of these projects of document reproduction. While this may be a cost savings to the designers, it increases the reproduction cost to the contractor for document reproduction.

An alternative to having the contractor reproduce the documents during the bidding stage of a project is to have the contractor estimate the project directly from the electronic documents. Takeoff viewers are software packages that allow estimators to perform their takeoffs directly from the electronic documents, saving the contractor the cost of reproducing the documents. The objective of the research conducted was to determine if takeoff viewers were developed enough to use in the takeoff process and what features were of the most value to the estimator.

Takeoff viewers are relatively new to the construction industry, therefore there was a limited number of people that were interviewed to obtain data concerning takeoff viewers. Rather than interviewing people that were selling the takeoff viewers, end-users were interviewed to help determine if takeoff viewers really could be used in place of paper documents.

## 2. INTERVIEWS

Sixteen different companies were contacted by telephone and thirteen companies responded. Nine of the companies used electronic documents. Of the nine companies, three used the electronic documents to only preview the projects to help determine if they wanted to pursue bidding them, one company used the electronic documents to print out the documents, and five of the companies performed takeoffs from the electronic documents.

The five firms indicated that they were estimating some projects entirely from electronic documents. These firms also indicated that they used electronic documents for 50% to 100% of the projects they estimated. One firm purchased a scanner allowing them to convert the paper documents to electronic documents for estimating. Two of the other firms paid an average price of \$1.25 per sheet to scan the paper documents so they could use electronic drawings for estimating.

The sources of the electronic documents for these firms are the internet, scanning, and CD's. The features that were found most beneficial to them when using the takeoff viewers were the following:

- The color code markups greatly enhance the communication between estimating and project management, saving a tremendous amount of time.
- The ability to reaffirm what was taken off a month ago.
- The autoscaling and measuring tools.
- The savings of time and the accessibility of the documents.

The drawbacks of using the electronic drawings were the following:

- The screen size and all the panning that is required. The panning makes the takeoff longer, but the colored printouts save time with the project management coordination.
- It is tiresome looking at the screen.
- The time to download the documents (from the internet).
- Handwritten changes to the documents are not shown on the electronic drawings.
- Flipping through the pages on the screen.

One comment made by an estimator is that while the electronic documents have made it easier and faster to obtain the project documents, he misses the personal contact with the people when he received the documents.

## 3. FEATURES

After the interviews were conducted, the author then obtained four takeoff viewers to verify the results obtained from the interviews. The four takeoff viewers used for this research were:

<u>Product &amp; Version</u>	<u>Company</u>	<u>URL</u>
On-Screen Takeoff 2.2	On Center Software	<a href="http://www.oncenter.com">www.oncenter.com</a>
BidScreen XL 1.0	Vertigraph Inc.	<a href="http://www.vertigraph.com">www.vertigraph.com</a>
FastBid 1.48	Builders Exchange of Washington, Inc.	<a href="http://www.bxwa.com">www.bxwa.com</a>
Takeoff Tool 1.1	US Cost Inc.	<a href="http://www.uscost.com">www.uscost.com</a>

The essential features of the takeoff viewer include the measurement of counts, line segments, continuous lines, and areas. As each measurement was taken, markup was placed on the documents indicating where the measurement had been taken. The markup typically consisted of symbols and/or text. The changeable attributes of the markup typically

consisted of changing the font, shape, color, and size. The takeoff viewers displayed the electronic drawings on the screen and some of the programs offered additional windows to assist the estimator. The first additional window is called the pan window; it is also referred to as an overview window or a thumb nail window. In Figure 1 it is labeled in red as a pan window. The black area in the pan windows show what is currently being displayed in the main drawings window. Another window offered by one of the programs is the conditions window. This allows the estimator to keep a running total of the items measured by the estimator. These windows can be moved and turned on or off as desired by the estimator. Only one of the four programs reviewed in this research offered both windows.

### **3.1 Count**

The first essential feature of a takeoff viewer is the ability to mark items on the screen and have a count produced. The size, color, and shape should be able to be modified by the estimator. This feature allows the estimator to perform multiple counts on the screen and clearly identify which items have been taken off.

The count feature also allows the estimator to move or delete an individual mark in the count. Some of the software packages did not allow this and this may require the count to be completely redone. All of the packages kept a running total of the count.

### **3.2 Linear Measurements**

The ability to takeoff lineal foot measurements was available in all the software packages. As the measurement was taken, a colored line was placed over the line that was measured. The color and width of the line could be changed in a couple of the software packages. The ability to change the color of the markup line was helpful when taking off several different lengths on the same screen, and the ability to change the width of the line kept the markup line from being too dominating or too small on the screen.

The ability to change or delete a line segment is an important feature. [This became obvious as sometimes left clicking the mouse was accidentally performed instead of a right click to see a pop up menu and a stray line was created.] Sometimes the undo feature would allow the researcher to erase the line and other times the line had to be deleted. It is important that the delete feature allows the deletion of an individual line rather than all the lines that have been taken off, otherwise, all the lines will need to be remeasured.

### **3.3 Area**

The area measurement feature was available in all of the software packages. Different methods exist between the packages for marking the takeoff area. One method is to draw a colored line around the perimeter of the area. Another method is to fill the area with a color or colored pattern. This option was problematic because it covered the area entirely which prevented reading the document information under the area. The last method was to fill the area with a pattern which left the background transparent. This clearly identified the area and also kept the information contained in the document readable.

Another function to look for with area feature is the ability to takeoff a large area and then be able to subtract a small area from within the previously measured area. If the estimator commonly performs this type of measurement, this may be a key feature.

### **3.4 Other Features**

The above features are essential. Without these features, the takeoff process would be very frustrating to the estimator. Other features that were: placing text notes on the drawings, using of layers with the markups, rotating the drawings, printing the colored markups, incorporating an organizational structure with the taken off measurements, and transferring the measurements into other estimating programs.

## **4. ESTIMATOR FEEDBACK**

An estimator for a general contractor was selected who had never used electronic documents prior to being contacted by

the researcher. This contractor is listed by ENR as one of the top 150 contractors in 2001(2001 ENR Top 400 Contractors, 2001). The estimator was given an hour of demonstration and training at his office. The estimator had an immediate use for the software because a designer had given him TIF images for the drawings and not hard copies. Prior to this estimator's use of the software he was plotting the documents from the TIF files onto full-sized sheets and then using a digitizer to obtain the measurements for the items he was taking off.

The main advantages the estimator saw in using the takeoff viewer vs. the digitizer were the following:

- Reduced cost of printing.
- Ease of referencing historical estimates.
- Accuracy increases since there is no question as to what has been taken off.
- Takeoffs are clean and presentable to owners
- Easier to do a take off without looking at two objects (digitizer/screen).

Disadvantages:

- Digital plans are not always [available].
- Viewing can be cumbersome, sometimes it is difficult when you cannot see the whole plan at a time. (B. Briggs, personal communication, October 10, 2001)

In a follow-up interview with the estimator (that had an immediate need for the software), he stated that on 50% of the projects he works on electronic documents are available. When performing a structural steel takeoff, he felt that he saved a day and a half by using the takeoff viewer over using a digitizer because of the stored markups and the running totals of the measurements.

## **5. SUBCONTRACTING**

Subcontractors will benefit from using takeoff viewers because with the electronic drawing they will be able to receive and keep a complete set of drawings whereas now it is common practice for them to receive a partial set of plan overnight from which their bid is created.

The benefits to the subcontractors of using electronic documents with a takeoff viewer are the following:

- The subcontractor can have a full set of the document which they can keep.
- The subcontractor can mark on the drawings to identify what has been taken off.
- Time is not spent waiting to use a set of documents.
- Money is not spent on copying the documents.

While general contractors will benefit from the use of electronic drawings, subcontractors stand to gain the most from the use of takeoff viewers. The benefits listed above should increase the productivity and accuracy of subcontractor estimators.

## **6. RECOMMENDATIONS**

Designers should offer construction documents in an electronic format to contractors. The creation of the electronic documents is no more complex than that of paper documents but would allow for greater distribution of construction documents. This should lower the project costs from the increased competition among subcontractors. Designers would also realize a cost savings in document reproduction.

## **7. SUMMARY**

The estimators that are currently using electronic documents are willing to pay to have access to electronic documents so they can benefit from the features that are available in the takeoff viewers. Estimators who have not been exposed to

takeoff viewers and are shown them, want to learn more about them and show them to the other estimators in the company. This research indicates that electronic documents are a viable means of takeoff for construction estimators.

The electronic documents generated directly from CAD have a higher image quality than electronic documents that are scanned. It also makes more sense for designers to create electronic documents for the contractor rather than creating printed copies of the documents which are then scanned by the contractor. The use of electronic documents should reduce reproduction costs for the designers and increase the accessibility to the documents for contractors and subcontractors.

The following is a list of benefits that come from using a takeoff viewer:

- A better means of distributing the documents to subcontractors.
- An alternate means of takeoff that operates similarly to a digitizer, yet is more accurate and modifiable.
- Easier archival of the plans for which the company has submitted estimates.
- Improved coordination of estimating and project management.

Takeoff viewers are developed to a point that they can be used by estimators to perform takeoffs. With the advantages of using the takeoff viewers over the traditional methods using architectural/engineering scales and digitizers, takeoff viewers are ready for main stream use.

## **8. REFERENCES**

2001 ENR Top 400 Contractors. (2001). [Internet]. Available: <http://www.enr.com/> [2001, October 17].