

Application of Time Management to Minimize Costs when Analyzing Construction Variances

Abstract:

Minimizing construction costs by reducing construction variances improves a company's competitive advantage, especially in a complex market. Using data from a construction company in the Dallas-Ft. Worth metropolitan area, variances were identified by studying a bar chart produced using a tool created with Visual Basic programming language that organizes data obtained from KOVA, a construction management software. Ninety percent of the time management spend organizing and filtering data was reduced using the tool. Consequently, Simple Linear Regression and Normal Distribution were applied to distinguish variances and create projections for future data. Statistical methods in conjunction with programming language and construction management software were proven to be a useful combination of resources to reduce construction variances, minimize costs and improve managements productivity.

Introduction:

Urbanization, inflation, COVID-19, and low interest rates are some of the variables that have impacted cost of materials and as a result cost of homes throughout the United States of America. One of the areas that has been affected is Texas, specifically the Dallas Fort Worth (DFW) metropolis.

In recent years there has been an upsurge of population in DFW; consequently, there is a home shortage and prices have increased dramatically. Competition has risen amongst residential homebuilders and to gain competitive advantage control of variances is imperative. Project cost control became a critical issue for the construction projects under global recession [1]. The same is occurring at this moment, but with inflation.

History Maker Homes (HMH) is one of the homebuilders located in DFW and whose business is booming. HMH owns four lines that cater to single family, luxury single family, town homes and rental homes. The production homebuilder has been in the market since 1949 and are targeting to build over 1,000 homes annually. To gain competitive advantage and increase the number of homes built annually in an inflated market, it is important to study an analyze variances to lower them as much as possible.

Problem:

There is limited research of the impact of using Visual Basic (VBA) programming language, statistics combined with construction management software to lower cost variances and reduce the time spent to trace variances in the homebuilding industry.

This study focuses on completion within target costs with special attention to material quantities. Organization and identification of data obtained from construction management software and identification of variances were found by using a tool created with Visual Basic programming language.

MiTek KOVA has been helpful streamlining the process of construction but there is a large amount of time spent organizing data that will then be used to identify variances and lastly find resolution to the variance. Time management is crucial when analyzing the data to minimize costs as well as to find solutions to reduce variances. The faster the company's variances are identified the larger the savings.

Objective:

The tool is used to reduce 25% to 50% of the time management spends organizing data. The goal is to save management time organizing data obtained from KOVA software and produce graphs to pinpoint areas of possible errors. The tool focuses on material quantity specific to a location, plan and specifications.

Meaning that when comparing data throughout months it is expected to see no fluctuations of quantities in data unless it has been noted otherwise. Gaps or changes in data when compared throughout the months will help pinpoint areas of unexpected variances.

Using statistical methods to analyze the data that was organized by the tool helps identify variances and create projections for future months after variances are corrected.

Methodology:

Visual Basic Code as a Tool for Data Organization

Data was obtained for one material using KOVA construction software. The material selection was one type of brick, and its units of measurement were square feet. The brick has been used in multiple homes throughout the DFW area by History Maker Homes. Quantity information for the brick was obtained by extracting reports from KOVA. The data was then pasted into a spreadsheet that contained the VBA Code. The Visual Basic Code was created to organize the data dependent on the user's needs. The user is to select the community, plan, and elevation they would like to obtain results for. Once the user clicked on the run button the code would filter through the data obtained from KOVA and as a result all the information for the material specified would be obtained in a separate spreadsheet with a bar graph. An experiment was performed to study the amount of time a user would take to filter through the data obtained from KOVA instead of using the tool. Three tests were done filtering the same exact data with and without the use of the tool to see its effectiveness.

Project variances and Cost Control integrated with KOVA

Once the bar graphs were obtained by using the tool then managers can analyze the data and quickly see if there are any variances. Managers should have knowledge on identifying variances and to be successful will need information regarding monthly changes affecting the data.

Statistic Methods and graphs to pinpoint areas of deficiencies.

Once the tool organizes the data this data can be used for further studies using it combined with statistical methods to predict future data. To analyze the Normal Distribution, the Mean (\bar{x}) and Standard Deviation (σ) of the data is calculated. Adding and subtracting three times the standard deviation to the brick square footage values and calculating its own probability density results in values that can then be used to graph a bell curve.

Results:

Time Management:

The tool can organize the data by community, material, plan, and month. Three tests have been run using the tool. Results show that the tool increases efficiency more than what was expected. The tool increased efficiency by 90%.

Table 1
Time spent in minutes organizing data

Test	Time in minutes without tool	Time in minutes with tool
Test #1	40	3
Test #2	18	2
Test #3	15	2

Graph Method to find Variances

The bar graphs are a visual representation of the data from KOVA reports and can be used to pinpoint variances. Figure 1 shows a quantity of 777 square feet in the months of February and March but shows zero in the month of April. This is a demonstration of a variance where data is missing.

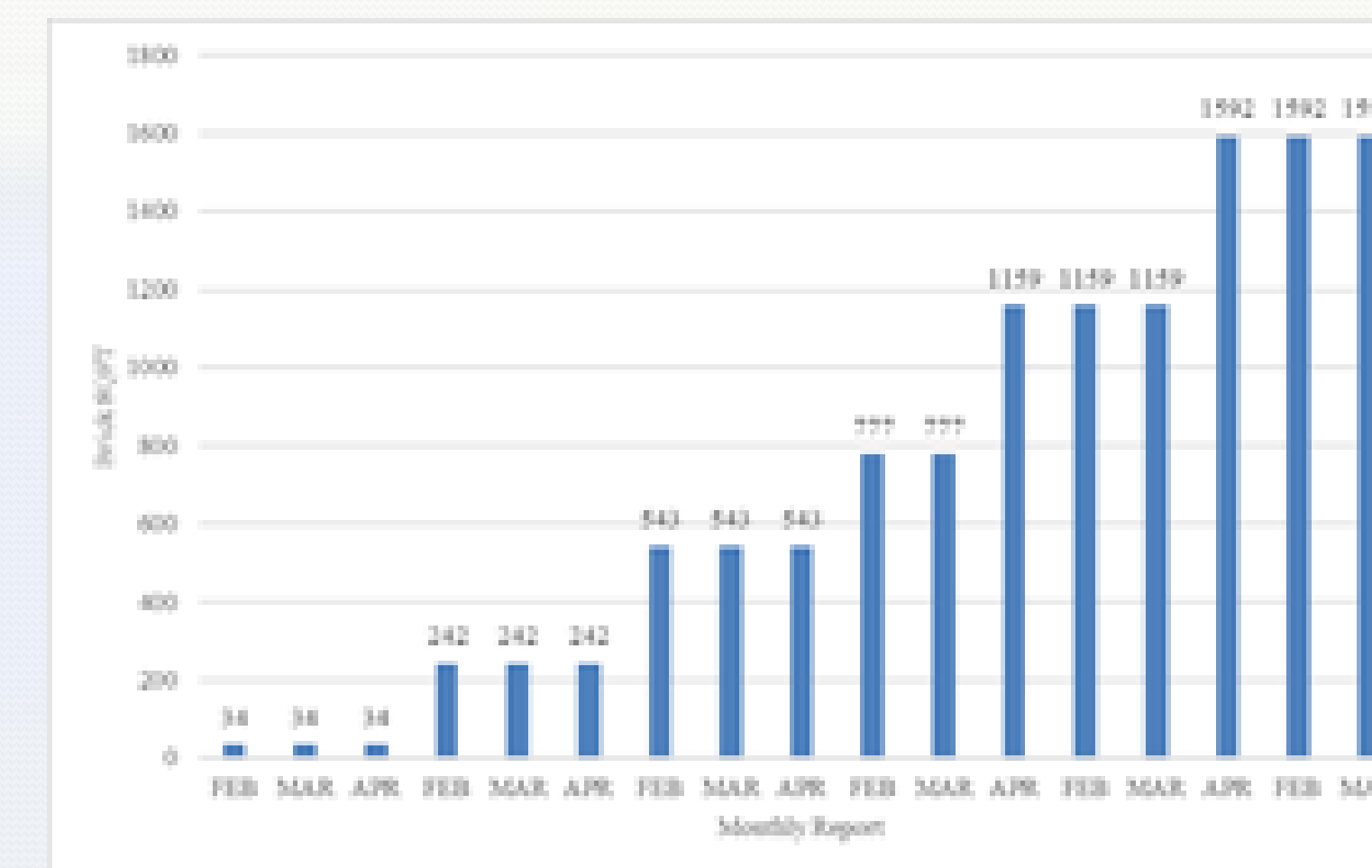


Figure 1
Brick SQFT by Monthly Report for Community C, Plan B and Elev. A

Simple Linear Regression Analysis for Variance Determination and Projection

The objective is to find statistic relationships of the monthly data to project the quantity data that is to be expected in the future. Forecasting helps pinpoint areas that may have a current variance that needs to be corrected and a prediction of future values in the upcoming months. From the data gathered by using the tool and once the data is graphed a negative linear regression is seen and month 3 data is missing, refer to Figure 2.



Figure 2
Simple Linear Regression Analysis for Brick SQFT by Monthly Report for Community C, Plan B and Elev. A

Normal Distribution

Normal distribution is a statistical method used to verify if the data is acceptable. The center of the normal distribution represents the mean of the data. 34.13% to the right or to the left of the mean for a total of 68.26% where most of the data should be included. If the data surpasses the 68.26% area, there is a high chance of a variance. Therefore, when analyzing data using normal distribution it is expected to have a bell curve that is not spread out as seen in Figure 3. Notice how the mean is 2904 and a -34.13% would result in 2903. This quantity is not correspondent to the cumulative square footage for any of the months. Meaning that the mean has been moved because of a variance. Table 2 shows the month of April having a lower total of square footage than February and March. The variance affects the Mean and as a result the values are not within 68.26% in the bell graph.

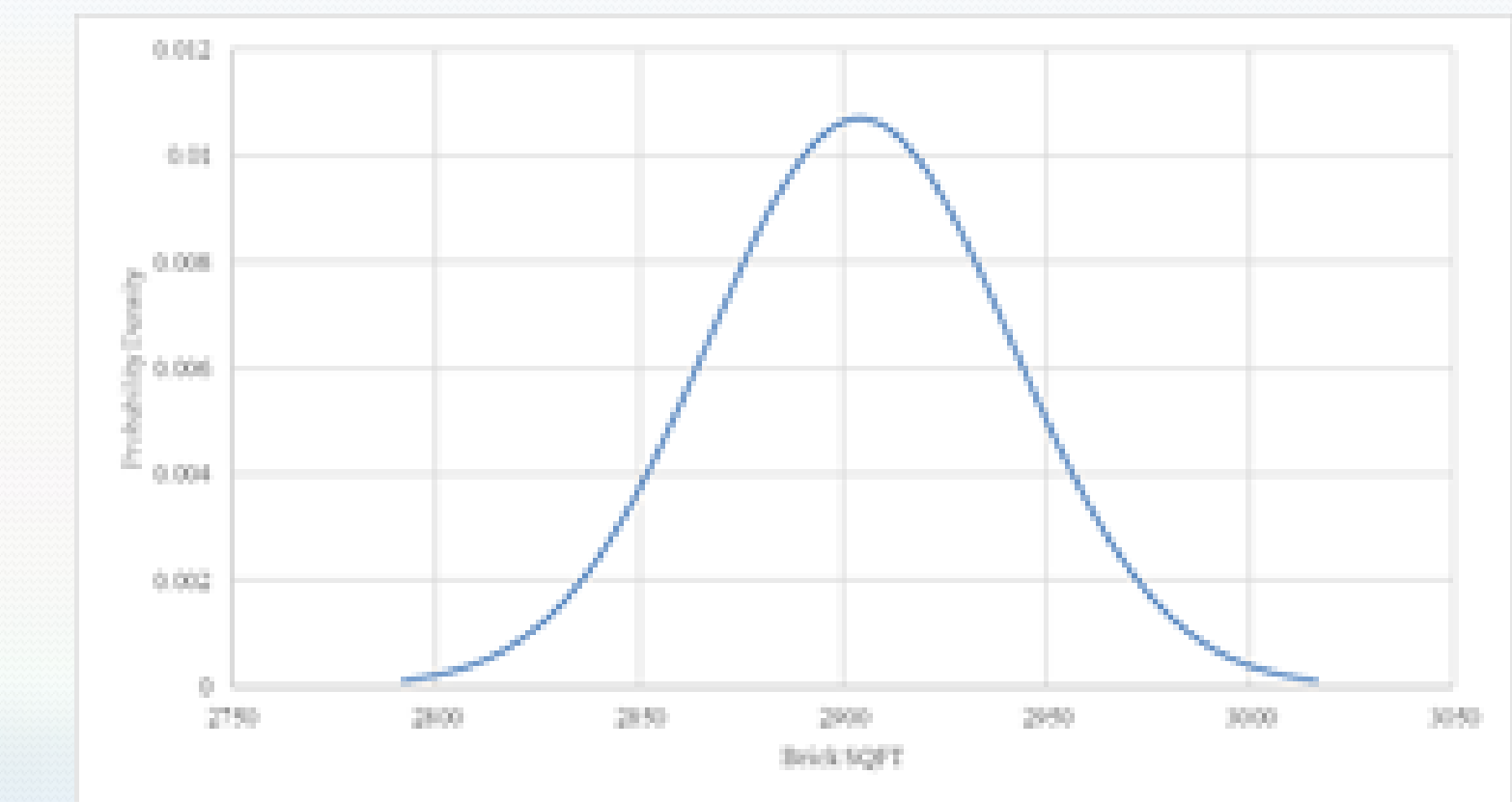


Figure 3
Normal Distribution for Community A, Plan A and Elevation A

Table 2
Brick SQFT by Monthly Report for Community A, Plan A and Elevation A

Monthly Report	Total SQFT
FEB	2926
MAR	2926
APR	2861
Mean	2904
SD	37.273

Conclusion

Using Visual Basic to create a tool that organizes data and creates bar charts to pinpoint variances has found to be a powerful resource that increases management productivity. 90% of time management spends organizing and filtering data is reduced using the tool. Simple Linear Regression and Normal Distribution in conjunction with programming language and project management software are useful in locating variances.

Because of the repetitive nature of production homebuilding, statistical approaches are easier and effective implementation to locate variances. Further research of the present methods is to be made to determine the best statistical approach to apply to projects within the United States of America with focus on the Homebuilding Industry for speculative and custom homebuilders.

References

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