Alternative Method for Budget Variance Analysis

Tracking Value Project Analysis:

Traditional project financial analysis is centered around actual costs and budgeted costs, usually in the form of differences and percentages. We have been experimenting with a new method, one that uses some statistical principals to help in the analysis.

This analysis puts a budget to actual cost variance into dimensionless, objective, & comparable terms. It does this by using the budget's natural standard deviation (SD). Any budget variance regardless of the units or magnitude is immediately comparable with all others. It uses standard quality control chart technique but with a twist, instead of using the same mean in the equation this assumes the mean changes each period and is the targeted value.

This method does not replace the traditional budget variance analysis, it augments that process. Anyone who knows the components in a budget and the components in the actual value can report what the differences are. However, how do you know if the budget used is representative of what you are trying to achieve? or that the actuals being reported have a significant correlation to the budget that they are being compared with. This may answer those questions.

Control charts are used to separate natural variation from assignable variation in a process. If only natural variation is occurring and it is assumed that the population or the samples are normally distributed then 67% of the samples or the entire pop. should be within +/- 1 SD, 95% +/- 2 SD, 99% +/- 3 SD and each value should have an equal chance of being above or below the mean. If a data point falls just outside 1 SD then there's a 33% chance it's natural and a 67% chance the variation is caused by something else, an assignable variation.
Control charts are developed to objectively determine if the system is "out of control" (variation is assignable not natural). Also they can be used to indicate if a budget plan is representative of the process (i.e.., string of actuals getting reported against the budget). I like the second usage, you always hear "thats a bad budget" this tells how bad and indicators are comparable between budgets with out regard to magnitude or units. There are many theories of upper & lower control limits criteria that can be used. Usually three or more in a row above or below the mean, or two of three outside 1 SD, consecutively increasing variation etc, means something is wrong. Industry and academia have developed a science on setting control limits and what do the values mean over time.

Our use of this practice works like this; we set up a excel spreadsheet that imports the budget values in labor units per the operating plan. This is spread by month for the fiscal year. Using this string of numbers a SD is developed (excel the formula for SD: STDEV (cells)). The SD represents the natural variation contained within the budget, much like if you took samples from a population and developed a SD to be used in process control. The standard control chart formula is (sample minus sample mean or expected value/(SD of pop or sample.) If we used the budget mean, the actual if not equal to the budget mean would give a variance (even if it was right on the budget). This is not what we are after so instead of using the budgets mean in the equation we use the expected value (budget) for that month. This assumes the mean changes each period and is the targeted value, which makes sense if it's the variance from the monthly plan you are interested in.

Another change we have looked at is instead of using the SD for the whole budget period is to use a rolling window of values. This keeps the SD more representative if the projects budget varies greatly, as in low numbers in startup and finish.

The rest is math; tracking value = (budget value – actual value)/(SD of the budget). The results of this equation are posted every month to a control chart with a zero line in the middle, months on X axis and +/-SD on the Y axis. It's this chart that is the final product.

At KSC, the Test Management Branch in the ISS/Payload Processing Directorate has been using tracking values for about 12 months to alternatively analyze our budget variances. It is one of our standard metrics presented every month. It has proved to be a value and has shown some trends that traditional methods would have missed. We are currently using it on two budgets. Chart A & B below contain actual data from these for the last 6 months. A quick analysis shows in August chart A indicates a possible control problem with 2nd consecutive positive tracking value having an increasing variance, this is confirmed the following month by a 3rd positive value that's outside the 1 SD control limit. Chart B while fluctuating positive to negative is less likely to indicate a control problem than chart A. All values are less than 1 standard deviation and while the last 4 values are consecutively positive 3 of those are less than .5 SD.

This method lends itself to be applied electronically against an unlimited number of small or large budgets, with the selection criteria set at whatever is desired. Tracking values or trend of values that met that criteria would automatically be sorted and reported for a more intrusive review. That's where I think the most value could be derived from the tracking value method; a rapid analysis of a great many budgets that would prioritize potential trouble spots, especially raising a flag early for budgets that are in a steady state or stable condition because they would have a very small SD causing a high tracking value for small variances.

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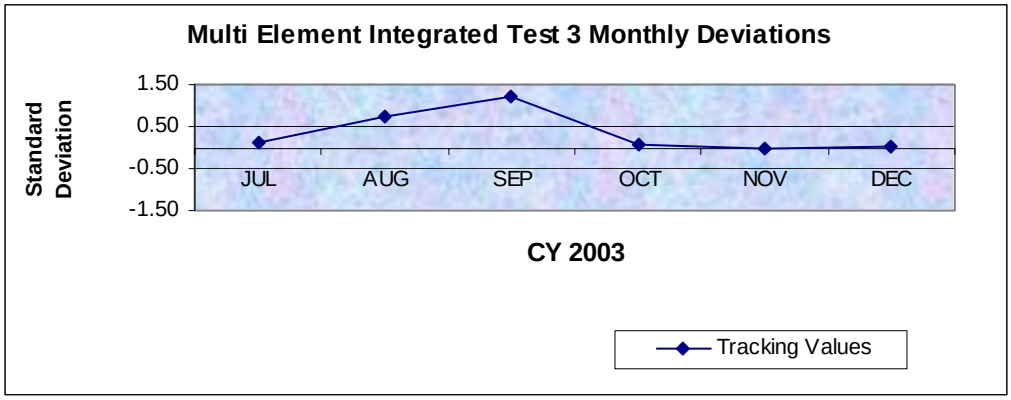

Chart A

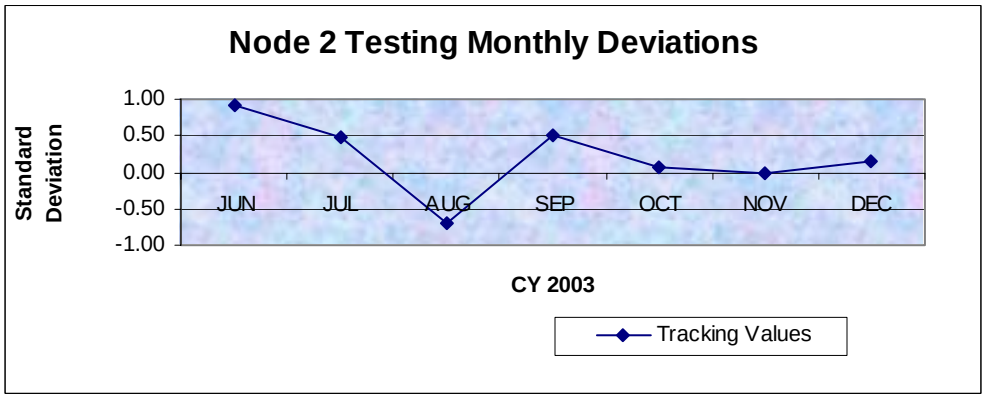

Chart B