

Are **SPREADSHEET ERRORS** Undermining **DECISION-MAKING** in Your Organization?

Your spreadsheets may be disasters in the making, as a new study makes clear. Here's what to do.

By Jonathan P. Caulkins, Erica Layne Morrison, & Timothy Weidemann

Spreadsheets are simple yet powerful analytical tools. Most nonprofit managers use spreadsheets to inform important decisions, including budgeting, strategic planning, and marketing. But spreadsheet errors are more common than most people realize. Without some quality control, spreadsheet errors may be undermining your decision-making.

Audits routinely show that many, if not most, spreadsheets contain errors. Even conservative estimates place the number of spreadsheets with errors at no less than 20%.

We recently completed a study to see whether those errors harm decision-making in the nonprofit sector. In short, the answer is yes. Most nonprofits hadn't implemented policies to ensure reliability of spreadsheet-based analyses.

Yet most quality-control steps are simple, requiring neither a Ph.D. in computer science nor additional funding. Below are some tips for improving your spreadsheets to assure sound decisions.

Spreadsheet Errors

The ease of spreadsheets has a downside: overconfidence, a phenomenon observed in countless studies of spreadsheet users. Simply put, people tend to believe their spreadsheets are more accurate than they really are. There are

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several common types of spreadsheet errors:

Design Errors. Structural errors, such as omitting an important dynamic in the model, are hard to catch. Yet they're easy to make. Such errors are common when strategic planning calls for modeling new situations. An example we encountered was a university administrator's mistake negotiating faculty royalties for overseas teaching. He had accidentally based calculations on dollars per class, not per semester, and was off by several hundred thousand dollars.

Calculation Inaccuracy. Arithmetic mistakes can range from parenthesis errors in a mathematical formula to a missed row in a summation. One nonprofit underestimated project costs due to "copy and paste" errors that pasted over formulas with constants. The organization now runs spreadsheets with test data numbers to ensure accuracy.

Poor Data Quality. Inaccurate data aren't limited to typos. Bad sorts, imports, and automatic queries can turn good data into trash. Small errors can aggregate

to large losses over time. In a small arts nonprofit, for instance, an error of several thousand dollars in fringe benefits recurred every year the spreadsheet was reused for almost 10 years.

Any one of these errors can jeopardize the accuracy of spreadsheet results. To catch mistakes, most nonprofit organizations rely on the "sniff test," a cursory review of spreadsheet output to ensure that the numbers look reasonable. Sniff tests typically find some, but not all, errors. So it's essential to apply more formal quality-control principles.

Quality-Control Principles for Spreadsheets

Too many nonprofits have a collection of ad hoc spreadsheets, built in individual "styles," that are poorly documented and understood only by their developers. Even if such spreadsheets generate the correct "answers" for their initial purposes, you should strive for spreadsheets that are:

- **validated**, ensuring that the spreadsheet model reflects the real world situation.
- **reliable**, meaning that the spreadsheet will be correct in identical circumstances.
- **auditable**, so that you can have confidence in its accuracy.

These three criteria are essential for critical decision-making tools.

The most fundamental quality-control principle is the need to manage spreadsheets throughout their organizational life cycle, including the following four stages:

Design: Some spreadsheets grow like country houses with so many additions that they're far more complicated than need be. Such poor design seldom results in a reliable, understandable tool. Large, complex spreadsheets should include design specifications. These design requirements should describe what the spreadsheet is meant to compute and what format input and output will take. A rule of thumb is that any spreadsheet whose logic doesn't fit on a single screen can benefit from an explicit written design.

Development: When developing spreadsheets under time pressure, many of us break cardinal rules, such as not typing ("hard-coding") numerical constants directly into formulas. Violating these rules is shortsighted. A classic maxim in software development is that "software maintenance" consumes more hours than does the original coding. Investing extra time in development will pay off later in reduced debugging. Equally important, cutting corners during development jeopardizes the spreadsheet's longevity. Given high rates of staff turnover typical of nonprofits, the goal should be to create a resource that outlives its developer and that can be adapted over time to new tasks.

Documentation: Another lesson from software engineering that carries over to spreadsheets is the importance of good documentation, both within the spreadsheet itself and as separate, stand-alone documents. Key formulas should be documented, but so should the underlying model logic and basis for business assumptions. Adequate documentation ensures that spreadsheet resources can be reused and don't become the sole property of one manager or analyst.

Review: The single most effective quality-control step is review by a qualified colleague, not just by the original developer. Consider having reviewers publicly sign off on their certification of the spreadsheet's quality. Larger organizations might designate a point person for spreadsheet quality assurance and enforce design guidelines through written policies and templates. Another rule of thumb is that 20-30 minutes should be spent on testing for every hour of development effort.

Five Steps to Quality Control in the Real World

Applying the highest quality standard to every spreadsheet in your organization may be impossible or inefficient. Instead, scale your quality-control efforts to the level of risk, and make sure employees understand this strategy. Here are steps to help you avoid disastrous consequences without breaking the bank:

1. Look at the decision the spreadsheet is designed to inform.

If the decision is important, take the time to design the spreadsheet well and review its accuracy. Weigh the impact of getting the decision right — and the

consequences of getting it wrong — by asking the following questions:

What's the impact of the decision? Is your spreadsheet helping you with a critical decision or just tallying your office-supply purchases? If a spreadsheet is used to make a single \$1,000 decision, don't spend hours checking it for errors. But if the spreadsheet forms the basis for a \$1,000,000 investment, spending only half an hour reviewing it may be penny-wise and pound-foolish. One prestigious health care nonprofit had a flawed spreadsheet that adversely influenced decisions with stakes in the millions of dollars!

Will inaccuracy damage your credibility? Never release an unreviewed analysis to the public, let alone to other parties in a negotiation. Even numerically small spreadsheet errors can lend fodder to political opponents and damage credibility with donors. Also, spreadsheets informing potentially litigious decisions demand extensive review.

2. Look at the spreadsheet itself.

A large or complex spreadsheet is more likely to have errors. Use these simple diagnostics for the likelihood of spreadsheet errors:

Complex Calculations. Users make more errors when formulas are lengthy, complex, or spread over multiple worksheets. Higher functionality, such as

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macros and automated linkage to other software, are powerful tools but can be more error-prone than simple summations.

Large Size. An average user makes errors in 1-5% of numerical cells.¹ So a larger spreadsheet will probably have many more errors and need more extensive review.

Many Users. When many people are involved, the need for quality control increases. Documentation, versioning, and auditing logs help with communication among multiple users or developers.

Likelihood of Reuse. The more often a spreadsheet will be used, the more time you should invest in making sure it's correct.

3. Provide a yardstick.

Consider giving employees guidelines to help them decide

How to Build More Reliable Spreadsheets

Design separate sections for data and calculations. "Modules" of information should be separated: data in one place, calculations in another. Then data can be easily updated and calculations reviewed for accuracy. Data should be entered only once and then referenced through formulas.

Break long formulas into small, digestible pieces. It's easier for reviewers to follow formulas that are short, with inputs located close together on the spreadsheet.

Include documentation. Even the developer may not understand the spreadsheet months later! Documentation assures that spreadsheets are organizational resources for shared decision-making.

Keep an audit log of changes and scenarios. Identify changes for reliability.

Implement version control. Don't overlook the basics, such as standardizing file-naming conventions.

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whether their spreadsheet needs more quality-control steps. A good example is available online from the New Zealand Treasury (available at <http://www.treasury.govt.nz/dice/reports/revspreadsheets.pdf>).

4. Offer training.

Some nonprofit executives worry that instituting quality-control steps betrays a lack of trust in staff competence. However, spreadsheet users of all skill levels make errors. Experienced spreadsheet modelers know this. Just as software developers make a fairly predictable number of errors per thousand lines of code, so do employees "programming" in a spreadsheet. Indeed, the intensity of quality control correlates positively with the sophistication of the employees creating spreadsheets.

Thus, it's a good idea to encourage training for anyone who works with spreadsheets. Experienced users create higher quality spreadsheets. Training can also help staff correct errors in colleagues' spreadsheets.² Find training which focuses on the principles of good design, rather than simply teaching more advanced features. You'll be better served by simple, reliable analysis than by complex models with esoteric features, whose reliability can't be guaranteed.

5. Foster a culture of quality.

While often overlooked, spreadsheet errors are a real problem that can jeopardize the accuracy of organizational decisions. Simple quality-control steps can improve spreadsheet management and promote accountability. Maintain a culture of quality by encouraging good spreadsheet design, offering staff training on error reduction strategies, and insisting on a full peer review of high-priority spreadsheets.

Specific guidelines depend on

your organization and how you use spreadsheets to inform the decision process. One nonprofit health care executive we interviewed combined training and review in a successful strategy. While he needed quality analytical reporting, spreadsheet development skills were secondary to the responsibilities of physicians in the practice. Through training and development, he dramatically improved doctors' reporting and analysis. Additional review of individual spreadsheets leveraged the benefits of conducting staff training. Spreadsheet quality control is now considered an integral part of organizational skill-building. ■

Footnotes

¹Panko, Raymond R., "What We Know about Spreadsheet Errors," *Journal of End User Computing*, Vol. 10, No. 2, available at <http://panko.cba.hawaii.edu/ssr/Mypapers/whatknow.htm>.

²McGill, Tanya and Jane E. Klobas, "The Role of Spreadsheet Knowledge in User-Developed Application Success," *Decision Support Systems*, 39, 2005.

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