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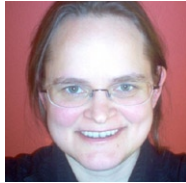
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The End Users Justify the Means: II

The Wrath of Numerate Decision-Makers

by Mary Pat Campbell



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It started out innocently enough. In May 2008, CFO.com featured a Q&A session with two professors talking about spreadsheet pitfalls that their business students often fall into, with tips and warnings for spreadsheet creators.

Then the floodgates opened and the responses to the article came fast and furious—peevish seems to be the most appropriate description of the responses. Some choice words from respondents:

- “Nearly every new college grad I hire has no idea how to actually create a spreadsheet that is ready to publish!”
- “One of the most annoying issues is the numbers not being in a common format, which makes the reading of numbers on the screen or on a printout very difficult.”
- “How many people actually test their spreadsheets? With the formulas hidden, it’s so easy to introduce a mistake and not even know it.”
- “I wanted to emphasize the horror of receiving a 20-tab or greater spreadsheet that does not delineate which tabs I, as the reader, should focus on.”

So far, CFO.com has run two follow-up articles on their original article on spreadsheet worst practices. (See references at the end of this article for links to these articles.) I would recommend reading the follow-up articles, at least, as none are long, and one can get the sense of frustration from this group of spreadsheet users.

In the preceding article of my current series, I looked at designing spreadsheets for use by the general public. While certain aspects of that user group require a lot of work and thought to provide the public with a useful tool, the user group of numerate decision-makers is likely to be the most exacting audience you will ever have to deal with. From the comments seen in CFO.com, the expectations aren’t necessarily high, but there are lots of details and features that the numerati will want.

Many actuaries are back office types, and their customers are usually the type of people who read CFO.com (a Web magazine geared toward financial execu-

tives). Excellence in spreadsheet design, alas, will not necessarily help in career advancement, and it is rarely taught, but adding to the frustration of the decision-makers will not have a positive impact on your position, that’s for sure.

Of course, one could fill books with spreadsheet best (and worst) practices, even for just the audience I have in mind: numerate decision-makers. As with my previous article, I will look at broad principles as well as some specific recommendations. There will be some overlap with my previous articles, but some principles cannot be overemphasized. You can also just skip over my content to the end—none of my ideas here are new, and you can go directly to the sources of these ideas. They will give far more details as to tricks and tips to accomplish certain actions in Excel; however, you need to think through the “why” before the “what” or “how.”

- Manage expectations, and know (and fulfill) standard expectations.

This is important in dealing with anybody in business, whether you’re dealing with them through spreadsheets or not. You want to make sure it’s clear to your end users as to what your spreadsheet does and, just as importantly, what it does NOT do.

This problem is solely one of communication, and you need to put information in appropriate places so that the user will actually pay attention to the information as needed. You also want to make sure the information is where it’s needed, and not tucked away in some auxiliary document that is easy to separate from the original spreadsheet.

For example, many times we can go overboard on the list of caveats, exceptions, and all those other minutiae that detail-oriented people love so well. But people will be overwhelmed when faced with a wall of text, and may not read your huge, long list at all. Figure out what is most important, and put it permanently in the spreadsheet display itself, or as a splash page (a window that pops up automatically when you first open the spreadsheet), or some other prominent reminder.

My own preference is to pick out one bottom-line important message; e.g., “This tool is intended for exploratory purposes, so FOR THE LOVE OF ALL THINGS RIGHT AND GOOD, do not use for customer illustrations.” (Excise the words in all-caps for a more professionally-worded statement.)

As for all the other piddly details, yes, put them somewhere, but hide them away. Maybe put in a button to take people to all the disclaimers, and for any kind of official printout, put them at the bottom in teensy print. If you have picked the unchanging aspects of your model appropriately, which are the sorts of things that would show up in the fine print, the user assumptions and this list should mesh. By all means, talk with the target end user before you start designing your spreadsheets, so that you know what they will expect your tool to do.

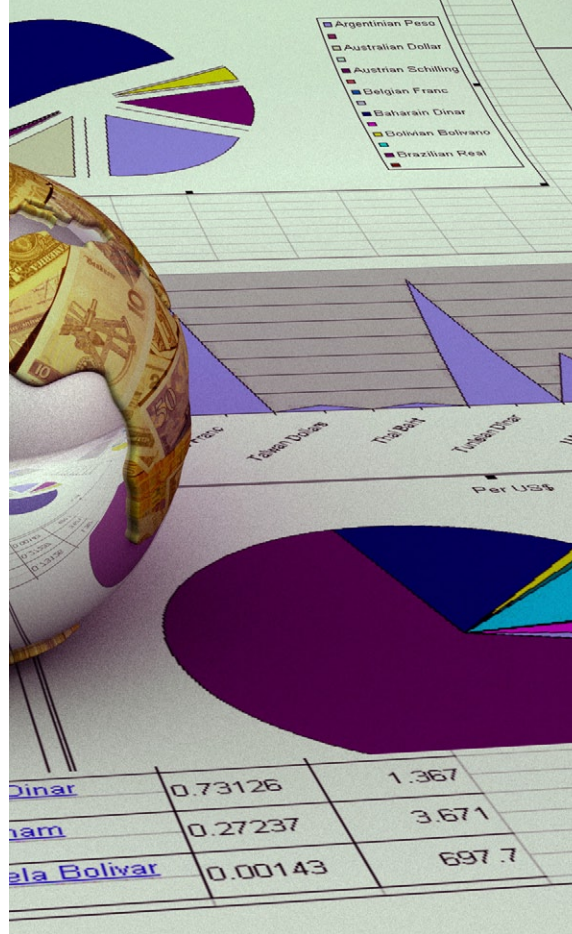
In managing expectations with regards to what the spreadsheets do, you want to make sure frustrations are low during actual operations. If you have any step in your spreadsheet operation that will appear less than instantaneous, have the spreadsheet announce it before starting the step, and if it’s going to take a minute or longer, make sure you have some sort of progress bar to let people know how much has gotten done (and if you can forecast how much longer it will take, that’s also useful.)

If you would like to know how to create progress indicators, I recommend any of John Walkenbach’s books on VBA programming for Excel (see references).

- Direct the flow and focus through the spreadsheets.

In the responses to CFO.com, many people mentioned the amount of confusion when they didn’t know where they were supposed to start in looking through the sheets in the workbook, couldn’t distinguish results from input, and in general had a tough time knowing if they were using the spreadsheet correctly.

When designing spreadsheets for numerate decision-makers, you’re more likely to have lots of input fields,



multiple pages, complex output, and in general, something that one cannot reduce to an iPod-like interface, or at least not a single screen with simple inputs.

I would map out the input flow before implementing in spreadsheet format. Below we see the principles I like to use:

- **Spreadsheet always opens to introductory or first input page.**

In the VBA code for the spreadsheets, you will see ThisWorkbook as one of the VBA objects, and you can put code in there (I did an example where upon opening a new version of the workbook was saved). So you can put in code such as this:

```
Private Sub Workbook_Open()

    Sheets("Start Page").Activate
    MsgBox("This is the first input page. Contact Mary Pat" & _
        " Campbell if you have any problems.")

End Sub
```

I use the Workbook_Open() subroutine as the place to put all my workbook initializations, including setting the first page for the user to look at, any warn-

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ing messages or messages as to version number or date of the last update.

- **More important assumptions are input before less important assumptions.**

This is going to work with a later principle, in that you're going to allow an out to users from any input page, if this makes sense. You have the user's attention the most at the beginning of the process, and they're more likely to flag or lose focus as they have to input more and more data.

To allow for easily-adapted spreadsheets, make sure nothing is hard-coded. ...

- **At most two input columns per page, and at most 15 rows of input.**

The main reason is that you don't want users to miss input fields. Once you expand beyond two columns of input (and you can set up input areas pretty clearly for two columns), you are starting to get into the dangerous area of input being overlooked or being off the screen view due to the user's preferences of font size or window size. I'm assuming you're using at least four columns for two input columns, with labels for the input to the left of where they're typed in (or chosen.)

Frankly, one column is safer still, but most of the time you don't have to worry about users cutting off a second column for input. When it comes to rows, you really have to test it for the set ups most likely in use. The basic concept here is to make sure that nothing important is overlooked by the user.

- **Clear Next and Previous buttons, when input and results are a multi-page process.**

Usually, even with sophisticated end users, I would turn off sheet tabs and have them navigate through the input screens using Next and Previous buttons (as well as clearly identifying how many pages they had to go through before results). In addition to controlling the flow through the spreadsheets, I would also do an input check every time the Next button

was punched, including looking for contradictions with input from previous pages.

- **Allow several exit points to results page.**

This works with prioritizing input as well, as if the input of less importance has a reasonable default set, or if it's likely the user will input that set once and for all and keep using that input set for multiple scenarios, just altering a few important items.

As with the Next button I mentioned above, I would always check that all input was OK, and ready to calculate final results, when a "Go directly to Results, do not pass go, do not collect \$200" button was pressed. When there was a problem, if possible, I would send them directly to the input fields that needed to be fixed or filled.

- **Results pages, within reason, should not require scrolling through screens—they should be viewable in one screen, with bottom line results (totals, ROI, etc.) as close to the top left as possible.**

As with input page design, you want to make sure the most important information is in the part of the screen that is most likely to draw the focus of users. In the English-reading world, top left is the default start point on a page of text; obviously, in other reading conventions, such as with Japanese or Hebrew, the default focus may be different.

- **Bulletproof your models, your code and your spreadsheets.**

Just as with the general public, you want to make sure that your spreadsheets do not crash in the middle of normal operation, and in the case of abnormal operation, meaningful error messages are given and recovery of data is possible.

Many times one cannot use traditional data validation for complex spreadsheets, but must check consistency between various input fields. As mentioned above, it's a good idea to check input reasonability throughout the input process, usually at key points, such as navigating to a new page. Give as much information as possible as to what about the input is

making the model choke, so the users can fix it for themselves.

Obviously, there will be errors the user will not be able to fix, and even though you're the one likely to fix it, it may help if you give some information as to where the error occurred (you never know, the person may have a staff member who can go into the code and fix the error—especially if you programmed the spreadsheet well). Any catchall error message should give direct contact information for the person who would fix any problems.

As mentioned in my previous articles for CompAct, one of the most crucial steps for bulletproofing your spreadsheets is to get other people to test them. It may help if you get someone who specializes in breaking spreadsheets, but these alpha- and beta-testers are likely to find issues that you are blind to.

- **Provide flexibility, customization and easy comparison.**

Numerate decision-makers like playing around with options, I've found; unlike with the general public, where I want a lot of the model nailed down, generally I've allowed every assumption to be played with when I have more sophisticated end users. Some assumptions are not easily changed, though, so sometimes I would customize the spreadsheet for use with a certain group. Where this is often true is having different input and output interfaces, where trying to satisfy all end user groups simultaneously can make for an unwieldy spreadsheet. To allow for easily-adapted spreadsheets, make sure nothing is hard-coded in terms of location—any cells being used in formulas should be referred to as named ranges.

One of the complaints amongst the CFO.com readers was not being able to compare two different input sets and their results, or being able to save their input without saving the entire worksheet. Allowing the saving of input and results is especially important for any spreadsheets that take a long time to calculate (say Monte Carlo modeling is involved).

In a recent working paper (“How can decision making be improved?”) published by Harvard Business School, it was noted that decisions can be improved when options can be compared head-to-head as opposed to in isolation. If your model calculates quickly, it may be a good idea to have mini-results areas on some input pages, so that one can flip through options to look at the impact of various choices. If the model is very complex, no matter how fast the spreadsheet calculates, it is a good idea to let the input be saved in its own file that can be loaded up, and especially to allow the results of two or more input sets to be compared against each other in the same display. This can be difficult to implement, but for crucial decisions, this will be well worth the effort.

- **Provide presentation-ready pages.**

What looks good on the screen may not look good on the printed page—or in Powerpoint or Word. I wouldn't prepare for all possible media displays (look good on a Blackberry? iPhone? Widescreen HDTV? At 4' by 8'?), but I would at the very least craft printable pages, as many people have trouble reading complex information off a computer screen (or, like me, want to make notes on the printout). It won't hurt too much to make them come back to you for special purposes, like preparing results for Powerpoint, but there's no excuse for not anticipating printing needs.

Standardize your formats. Make the styles (font, color, borders, other embellishments) reasonable, few and simple. Consider making printable pages separate from your regular output views, and if you do so, make a prominent “Print Results” button on your results pages, so that users do not unthinkingly hit “Ctrl-P” (though you can override that, too.)

If your results pages will work well as-is for printing, make sure you set the Print Area and default printing options for each page. If you're using sheet tabs to help identify pages, make sure that you have a header or footer identifying the page and workbook (one peeve from a CFO.com reader). When it comes to printed results, more information is usu-

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ally better than less, as people can absorb the information on the page at their leisure, and the printed page, far separated from the original program, loses all its context without more explicit labeling.

In designing printable results pages, consider how well the pages will look in black and white as well as color. Even if you know that users will print out pages in color, they may photocopy the pages into black and white. Anything intended for printing should be distinguishable in black and white. That means, for plots, you should vary the line pattern and line weight to help distinguish when you have multiple data series in a graph. Also, do not use highlighting or light-colored fonts for emphasis, but use borders, and italicized or bold fonts, to make the text stand out.

- **Design informative graphics, and eschew plots that mislead.**

There have definitely been books upon books written on this topic. My first encounter with such ideas was *How to Lie with Statistics*, a decades-old book with very dated statistics but very relevant information on misleading graphs (amongst other things), especially in this era of USA Today infographics ... almost all of which break the rules from this book.

Not everything requires graphics, though you may be asked to design dials, pie charts, and the like. When there are only a few numbers to compare, it is probably best to keep the numbers in table format. Pie charts are invariably misleading because they are difficult for people to really internalize, and most importantly, it's almost impossible to compare two pie charts. As several scenarios will likely be tested in using the tool, make sure if graphs are to be compared all graphs will be on the same axes scale; I've seen people misinterpret results because the visual differences were very obvious ... but the

In designing printable results pages, consider how well the pages will look in black and white as well as color.

plots were on entirely different scales. Some 3-D plots are also a bad idea because they are hard to interpret visually.

While graphics mislead, sometimes bare numbers can mislead more. One place where I think graphics are required is when one is showing correlations—you should have scatterplots here, and if the correlation does not satisfy the “interocular trauma test” (i.e., it hits you between the eyes), the correlation is probably bogus, just a statistical artifact.

Anyone who does heavy-duty quantitative analysis should check out Edward Tufte's books for guidance on how to best display the information. Tufte gives examples of best-in-show as well as horrendous graphics. The *Visual Display of Quantitative Information* is a good starting point for exploring Tufte's work.

In addition to plain graphs, one information-display technique that is in vogue amongst the numerati are dashboards. They are intended to provide easy comparisons at a glance, or keep people updated as to the state of the business. Check out the links in the references for good examples of dashboard design. When designing dashboards, you're trying to display a large amount of information in a few graphics, and trying to make it as simple as possible so that multiple lines may be compared against each other. Dashboards can be created with or without VBA, requiring connection to databases or not. As with other informational devices, you need to make sure the information can be digested by the user, and is not too dense to be useful.

- **Own your spreadsheets, and control your versions.**

As with bulletproofing, this is a recommendation I'm making for spreadsheets, no matter the end user. The reason here is a little more political, though. In addition to reducing the frustration of users by letting them know who should be contacted, if you've done your job well, surely you want the decision-makers to know who you are.

As mentioned at the beginning of the article, excellence in spreadsheet work is rarely noted by the end user. Most people only notice technology when it doesn't do what they want it to, And the perfect technology is that which is invisible, so if you've done your job well you probably won't hear anything from anybody. That said, spreadsheet users are voracious in their appetites, always wanting more features or new tools, and they certainly would want to contact the person who did the work the last time. You don't need to put an animated graphic of fireworks around your name; just make sure that if the user wants the information, it's easy to find, such as putting the contact information on an introductory page or having an "E-mail comments" button on a page.

Version control is also crucial. If your tool is going to be used by a variety of end users, you're going to have a large range of versions out there in the user cloud. Make sure version number is prominent in any About page, and as the version number is likely to mean something to you the designer, and not the user, also put a date for the version in the identifier, so it's readily apparent when someone has an out-of-date version.

I usually keep a version history in the spreadsheet itself, on a page by itself, giving the version numbers, dates, any important changes/differences between the versions, and a list of people who have worked on each version. I hide this sheet, but any user can unhide it and look at it for themselves, so they can request a previous version if that suits their need better, and it also gives them a development history.

I plan on closing out this series of articles by writing on design with auditors, testers and maintainers in mind. As with the CFO.com authors, I would appreciate hearing your own experiences, tips, pitfalls, etc., whether for the end users I have already covered, the ones I'm going to cover, or ones I didn't even consider. Too often, we back office types toil in anonymity, and the information-sharing can really improve our game.

Please contact me at marypat.campbell@gmail.com. I look forward to reading your comments! ■

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Edward Tufte

Home page: <http://www.edwardtufte.com/tufte/>

Writings: <http://www.edwardtufte.com/tufte/newet>

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Dashboards

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Other links

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