Visualizing Spreadsheets
Add exponential value to Excel for Monitoring, Analysis and Modeling

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Microsoft Excel has been widely adopted as an easy-to-use and powerful tool for free-form data manipulation. Excel has evolved beyond a simple data calculation tool to the point where it is now used as a sophisticated and flexible repository for collecting, analyzing and summarizing data from multiple sources. People use Excel to track travel expenses, devise budgets and forecasts and create reports. Some power users are adept enough to create advanced pivot tables and macros that rival the work of IT programmers.

The power of Excel can be leveraged with visualization in many different ways: enhancing effectiveness, focusing communications, helping make anomalies pop-out, facilitating comprehension and empowering collaboration:

1. Effective Reports

Over the years, Excel has added a host of advanced charting and cell formatting features to facilitate reporting. However, providing more interactive forms of data representation can provide much more utility to rapidly assess data. Consider the following simple example of a risk report:

Figure 1: Before and After Visualization Reporting. The spreadsheets on the left represents two pages out of a risk report with approximately 100 pages of risk scenarios (left image) and resultant impact (center image, generated by standard Excel charts). The same report presented as an animated and interactive visualization (right) consolidates all 100 pages of the information into a single screen. Image s © 2005 Oculus Info Inc.

Using visualizations with Excel for reporting provides:
- *visual structure* to help bring together many different types of metrics with potentially different scales and frequencies;
- *multiple representations*, so that summaries, intermediate aggregations and specific details can be presented in a single interface; and
- *interactions* for easily navigating through the various data levels with features such as drill-through tooltips and overlay charts as well as playback animation.
- *visual correlation* between the drivers and inputs to the report, to help give an indications of causal effects.

This visualization of the report enables the viewer to instantly see relationships between metrics. By visually grouping related information and adding the ability to see visual patterns across a field of metrics, productivity is increased. As one user said: "With the visualization, in 10 minutes I knew more about the current situation than the subject expert beside me."

2. Focus Communications

Excel charting combined with PowerPoint have achieved near ubiquity in presentation – can visualization add more value? Consider the familiar time series data presentation. A traditional line chart displays the entire time series equally in two dimensions, but does not draw attention to recent data:
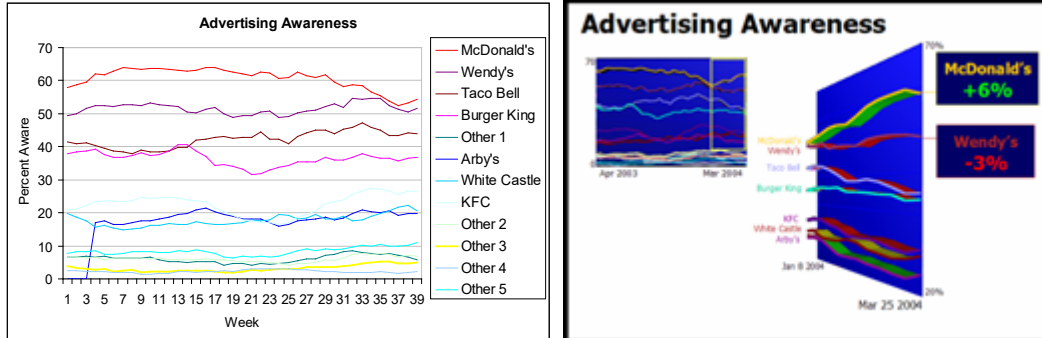

Figure 2: **Before and After Visualization Communication**. The traditional line chart, left, displays all data equally without any emphasis on recency. What is the key message the author intended to communicate? McDonald's dominates awareness? Wendy's is narrowing the gap? There is a big difference between the top 4 and rest? The time series on the right displays the overall context (upper left), a focus on recent top performers (center) and calls out the message explicitly (McDonald's up 6 %, Wendy's down 3% after a key marketing campaign launch). Image s © 2005 Oculus Info Inc.

Visualization can provide both detail and focus attention in ways that standard charts cannot by using:
- *visual design,* such as overall organization, perspective and color cues; and
- *visual interactions,* such as animation, highlights, and callouts.

An Excel chart can consolidate a lot of data and tell many stories. Unfortunately, the intended audience may be left to find and decode the message on his own. Alternatively, visualization can be designed and presented to help draw the viewer's attention to the key point while retaining the relevant context. The message is communicated more effectively. As a market researcher said: "We are in the business of communication and visualization gives us a competitive advantage."

3. Pop-out Analysis

Excel is often used as a general purpose data analysis tool. Powerful sorting and filtering functions as well as conditional formatting can help users to try to understand their data. Consider the following example of pricing data:
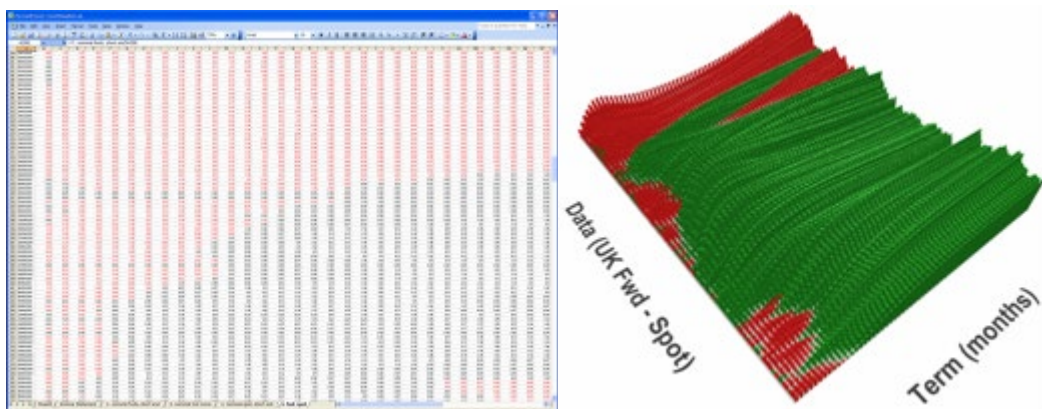

Figure 3: Before and After Visual Analysis. The dataset is 522 days by 60 months of currency pricing data. The spreadsheet on the left can view only 80 rows x 32 columns showing only 2560 values. The visualization on the right shows the full dataset: 31320 values; more than 12 times the amount of data visible in the

spreadsheet. Additionally the visualization makes patterns visible that are otherwise impossible to see in the spreadsheet such as twists and dips over time as well as isolated anomalies lasting only a day or two. Image s © 2005 Oculus Info Inc.

When working with larger datasets, visualization can:
- clearly show *more data* than can be seen in the same screen real-estate with either a spreadsheet or chart
- make *patterns visible* that are otherwise difficult to perceive within the spreadsheet.

Using visualization together with Excel in a data cleansing application increased the team's efficiency and quality: "With visualization, the anomalies jump right out," said one particular data warehouse manager. Since the warehouse data was used in downstream risk forecasting algorithms, improved data quality led to the reduction of risk thresholds, consequently freeing up millions of dollars in capital.

4. Understand Models

When building spreadsheets with many formulas, it can be a challenge to try to understand the impact of a change and explore various what-if scenarios. Consider the following credit modeling application:
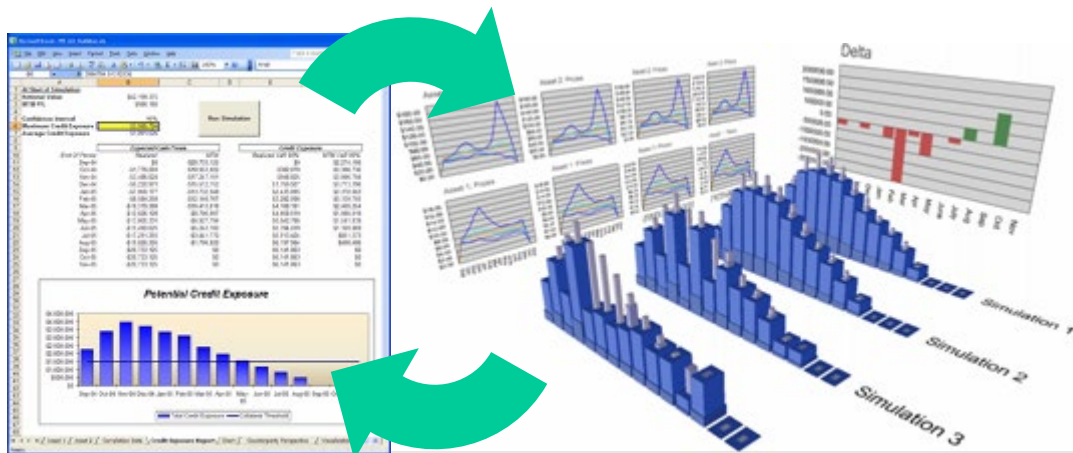

Figure 4: **Before and After Visual Modeling**. The spreadsheet at left provides a snapshot of a potential transaction. The visualization on the right is updated each time the user creates another potential transaction and adds it as another row (on the floor) and another pair of charts (on the wall). The viewer can then pick and compare any pair of transactions (shown on the back wall) to better understand the tradeoffs and determine which scenario is best. (Credit spreadsheet from Risk Solutions Inc., image s © 2005 Oculus Info Inc.)

When working with spreadsheets filled with formulas visualization provides:
- *intuitive insight* into the underlying dynamics of the formulas – the viewer can learn how and where the model reacts to different inputs; and
- *rapid iteration* by enabling the viewer to easily manipulate many input variables and visually assess the impact across the range of output variables reduces the time and effort to explore alternatives.

The original appeal of the spreadsheet was the ability to construct powerful and flexible models. Visualization can leverage this power by providing rapid insights though an intuitive visual interface. Making complex models visible and tangible is one of the most compelling applications of visualization, providing not only gains in productivity and efficiency, but also improvements in collaboration. For example, one company using a spreadsheet visualization of merger and acquisition scenarios, was able to quickly reach consensus on a significant divestment one quarter sooner than they would have been otherwise.

5. Exception Monitoring

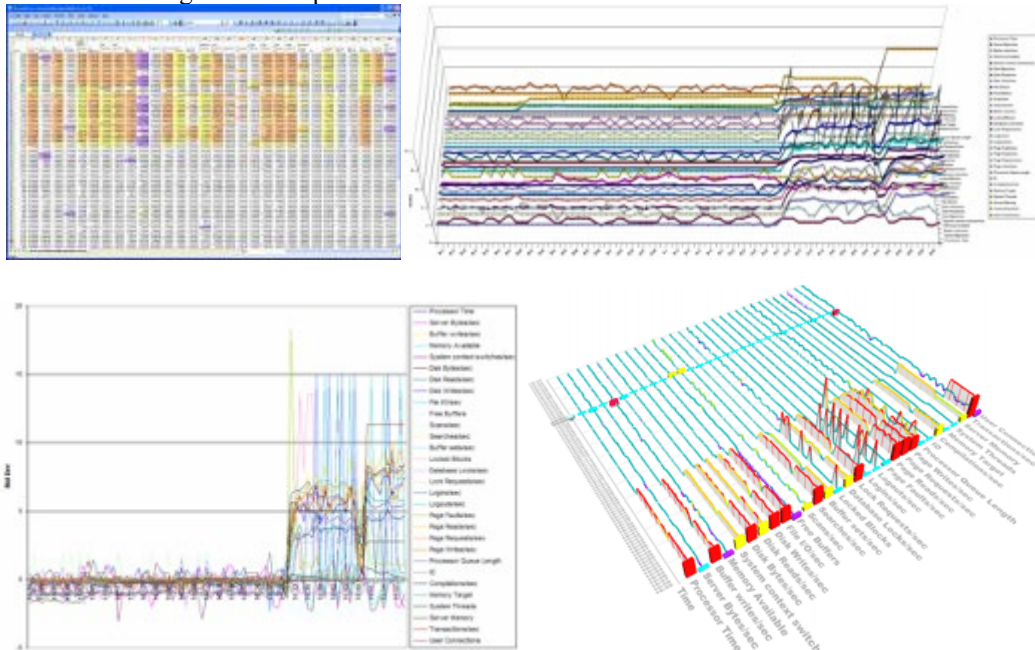Consider the following real-time spreadsheet and associated charts:

Figure 5: **Before and After Systems Monitoring**. The spreadsheet provides a central place to collect all the metrics in real-time but it can be hard to decipher meaningful patterns, particularly when many things happen at the same time. Built-in 2D and 3D charting have many overlapping lines that are difficult to decipher and correlate with the legend. The visualization provides the same data and makes it easy to pick out outliers and the associated metric label. Image s © 2005 Oculus Info Inc.

For tasks that require tracking data in real-time, a simple and well designed visualization of Excel based data provides:

- *clear separation* of multiple data elements by providing space between each data series and providing interaction such as navigation and data slicing to help highlight data of interest
- *clear labeling* of data series by providing labels with each ribbon as opposed to a legend that becomes impossible to correlate across 30 different colors.

Excel is now often used to track real-time data, such as financial market data and derived calculations. Visualization leverages Excel's real-time and analytic functions to provide a clear, immediate view into the underlying data. As a stock market vice president says: "It's tough to beat visualization when it comes to providing an immediate understanding."

6. Collaborative Planning

Excel is often used to analyze complex data across multiple worksheets; in tasks as varied as planning, budgeting, scheduling, supply chain management, and fraud investigation. Attempting to understand various types relationships between different entities and events across time and geographies is difficult to convey and represent. Visualization can express these relationships with intuitive graphics that consolidate vast amounts of worksheet data into a single visual representation:
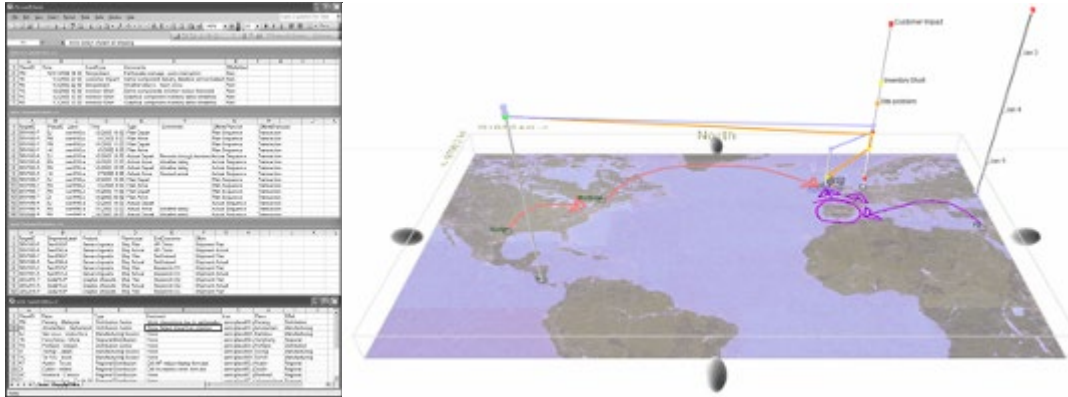
Figure 6: Before and After Visual Supply Chain. Multiple spreadsheets contain different supply chain shipment attributes – shipment manifests, shipment route and tracking, location details, etc. It is complicated to plan and coordinate future events with only the spreadsheet. The visualization depicts both geography (on the floor) and time (along the height axis) to show movement over time. For example, the orange line represents a shipment routed through Costa Rica to Amsterdam to Dublin. Viewers can click and drag shipments to explore alternatives, (e.g. the red arrows consider a shipment from Austin through Montreal to Dublin), thereby facilitating collaboration and resulting in more efficient utilization of limited resources. Image s © 2005 Oculus Info Inc.

For planning tasks in conjunction with spreadsheets visualization facilitates:

- *enhanced comprehension* of complex relationships by creating a simple depiction of many simultaneous attributes; and
- *collaborative resolution* by enabling multiple viewers to sketch out many different alternatives and consider the potential trade-off decisions.

Spreadsheets are used to correlate disparate data elements and evaluate alternative resolutions. As one user of an Oculus planning application stated: "Visualization enables new operational concepts."

The Benefits of Spreadsheet Visualization

Excel is a near-ubiquitous and flexible application for aggregating and summarizing data from many sources. Adding the ability to gain insight and comprehension of Excel data in each of the cases above, visualization enhances people's ability to explore, correlate and comprehend data while gaining more insight with greater clarity.   With large and complex data sets, simple charts and graphs, do not go far enough to give sufficient insight.

At stake are the underlying data and decisions that drive business every day. Better decisions achieved more quickly and with greater confidence as a result of visualization has the power to provide a ten times or even a hundred times return on investment. As one banking senior vice president said, "Using visualization we learned more in two weeks than we had learned in the previous two years". Or, in other words, using visualization on top of the spreadsheets that were currently in use, they achieved more than a 50 times performance increase.

References

All images and datasets are courtesy of Oculus Info Inc (www.oculusinfo.com). The credit spreadsheet in figure 4 is courtesy of Risk Solutions Inc (www.e-rcm.com). Data shown is either from Oculus Info Inc., or from public sources including bankofengland.co.uk and nasdaq.com.